# ELECTRICAL REVIEW

January 31, 1947

## Contents :—

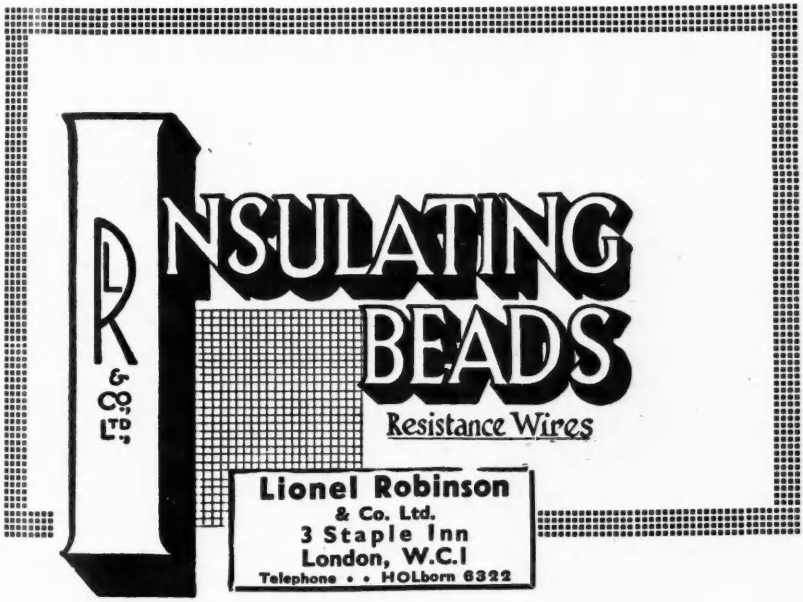

| | Page |
|---|---|
| **EDITORIAL**—War Record | 193 |
| **ARTICLES**— | |
| Motor Installation and Maintenance—I. By "Rotor" | 195 |
| Power Station Construction | 198 |
| Turbine Clearances. By H. Barson, A.M.I.E.E. | 211 |
| What is Ohm's Law? By G. W. Stubbings, B.Sc., A.M.I.E.E. | 225 |
| Colour Films | 229 |
| **PAPERS AND ADDRESSES**— | |
| Electrical Machine Design | 212 |
| Measurement of Light | 238 |
| **REPORTS**— | |
| Picture Transmission | 197 |
| Portsmouth Apprenticeship Scheme | 204 |
| Commissioners' Report | 205 |
| Overseas Electrical Trade | 213 |
| Luton Enterprise | 217 |
| **REPORTS** (*continued*)— | |
| Soil Heating | 223 |
| H.V. Cable Demonstration | 223 |
| Sheffield Activities | 224 |
| Supply Workers' Wages | 226 |
| **NEWS SECTIONS**— | |
| Personal and Social, 207 ; Commerce and Industry, 219 ; Electricity Supply, 227 ; Financial, 231 ; Contracts, 239. | |
| **CORRESPONDENCE** | 218 |
| **VIEWS ON THE NEWS** | 210 |
| **PARLIAMENTARY** | 215 |
| **FORTHCOMING EVENTS** | 236 |
| **NEW PATENTS** | 237 |
| *Classified Advertisements* | 59 |
| *Index to Advertisers* | 100 |


Managing Editor :
Hugh S. Pocock, M.I.E.E.

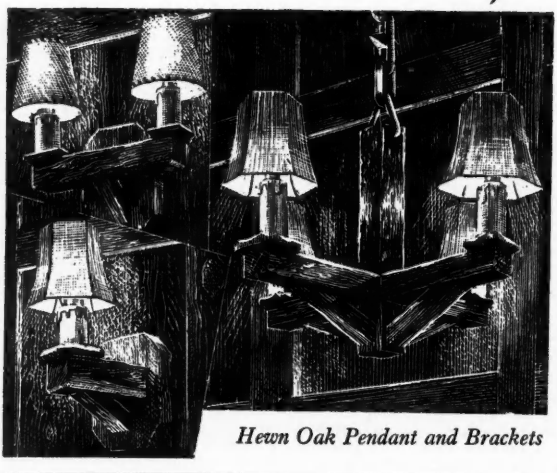
Technical Editor :
C. O. Brettelle, M.I.E.E.

Industrial Editor :
J. H. Cosens

**EDITORIAL, ADVERTISING & PUBLISHING OFFICES : Dorset House, Stamford St., London, S.E.1**
Telegraphic Address : "Elecrev, Sedist, London." Code : ABC. Telephone No. : Waterloo 3333 (50 lines).
Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage. Entered as Second Class Matter at the New York, U.S.A., Post Office.
Annual Subscription, Post free : Great Britain and elsewhere (except Canada), £2 7s. 8d. ; Canada, £2 3s. 4d.
Cheques and Postal Orders (on Chief Office, London) to be made payable to ELECTRICAL REVIEW LTD., and crossed "Lloyds Bank."



# "It has that 'Berry's' look..."



*Hewn Oak Pendant and Brackets*

*THE tradition of craftsmanship which has made MAGICOAL a household word is maintained with equal care throughout our whole range of Decorative Lighting.*

Berry's

# CAMBRIDGE

## ELECTRICAL & MECHANICAL INSTRUMENTS

CAMBRIDGE
INSTRUMENT CO. LTD.
13 GROSVENOR PLACE
LONDON S.W.1

AS the CAM and the BRIDGE are mechanical and electrical symbols, and CAMBRIDGE is a seat of science and learning, so CAMBRIDGE PRODUCTS bearing this trade mark embody the scientific application of engineering principles in design. Sixty years of continuous development have gone into their making.

Data of over 120 ELECTRICAL INSTRUMENTS are given in FOLDERS 53-X and 54-X.

WORKS: LONDON AND CAMBRIDGE

# ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXL. No. 3610 JANUARY 31, 1947 9d. WEEKLY


# War Record

## Electrical Progress Maintained Despite Handicaps

In the Twentieth Report of the Electricity Commission published yesterday is given a consecutive official account of the electricity supply industry from the beginning of April, 1939, to approximately the end of the war in Europe. Much of the most notable information it contains has already appeared from time to time in our columns where it was presented as soon as it became available, but there are many other details likely to be of interest to those who require to know more about the less obvious aspects of the great part played by electricity supply when put to a supreme test.

### Strain on Generating Plant

To those outside the industry with memories too short to recall the debt all owe to it on that account, who are inclined to throw the blame on its organization and management for present deficiencies from pre-war standards, the facts here recorded should speak for themselves. To cope in 1945 with an output exceeding that of 1938–39 by 60 per cent with only 36 per cent additional generating plant capacity was in itself, after making full allowance for higher load factor, a remarkable feat. Since then the situation has relatively worsened and much of the older plant is rapidly wearing out.

The responsibility for the present situation is placed squarely where it belongs. The extension programmes, agreed as essential between the Commissioners and the Central Electricity Board, were not always approved by the Government, which categorically absolved the C.E.B. from responsibility for any inability, as a result of the necessary wartime restrictions on manufacture, to meet the post-war demands it anticipated. It is shown that even those programmes which were sanctioned in detail had to be modified owing to the rapid changes in circumstances, entailing sometimes the postponement of construction which was further delayed by difficulties in securing " priorities."

Added to the claims of other war industries on scarce materials was the growing demand on the greatly reduced labour force available. Apart from diversion from the manufacture of electrical apparatus, there was a reduction of some 25 per cent in the number engaged in supply work, and this resulted in inability to maintain the plant adequately, although the period allowed for the work was (and is still) extended at each end of the summer so that it seriously reduced the margin of spare plant available during the seasons of heavier demand.

### Coal Stocks and Quality

Unsuitable and variable coal has reduced ability to cope with the peak by some 300,000 kW. Regarding actual shortage, it makes strange reading now that in March, 1940, undertakings were urged to build up their stocks to not less than ten weeks' reserve on the basis of maximum weekly consumption in the winter, since under present conditions ten days in hand seems about all that can be hoped for in many cases.

The downward trend of lb of coal per kWh sent out, which was achieved year

by year before the war, could not be continued. Difficulties in the boiler house in burning the sorts of fuel delivered were not the only ones; for security reasons, uneconomical plant was run for longer periods than would otherwise have been necessary. Now it is run to eke out plant capacity in the face of still rapidly mounting demand. But the price of electricity to domestic premises, unlike that of other commodities, actually fell during the war and for all purposes was less than 3 per cent above pre-war charges. Criticisms as to tardy development, e.g., in rural areas, do not take into account a decision of the Government under which undertakings were required to restrict capital expenditure to war requirements and the most pressing public needs. The further particulars from the Report which are given in this issue will show that, whatever reasons may be advanced for a drastic reorganization of electricity supply, failure to meet the needs of the public in circumstances of extraordinary difficulty, cannot be included among them.

**Discharge Lamps**

CONSIDERABLE further developments are to be expected in connection with the high-pressure mercury-vapour discharge lamp, as was made clear in the I.E.E. paper by Messrs. V. J. Francis and W. R. Stevens. Even higher luminous efficiencies, better colour rendering and virtual elimination of delay in restriking the arc after interruption are among the improvements that are on the way. These will find their applications in street lighting, television and film production (in which the heat and noise of the carbon arc are serious drawbacks). In the meantime, however, full advantage can be taken of what the present stage of progress has to offer, since discharge lamps are for these purposes so great an advance on any earlier methods.

**Colour-Blindness**

INABILITY to discriminate properly between colours concerns the electrical industry principally in two ways. The first is in illuminating engineering, where difficulties increase with the growing use of discharge lamps the light emitted from which is concentrated in a few lines or a narrow band of the spectrum. The disability here appears to be uncommon and a relatively minor factor. In the second case, however, colour-code matching of wires and dielectrics may involve questions of safety. In a report of the Physical Society on Defective Colour Vision in Industry, prevocational tests under working conditions are recommended where normal colour vision is important. Working conditions imply that samples of coloured insulation should not be cleaner than they ordinarily are after use and that the lighting should be not better than that found in the average workshop.

**Overseas Trade in 1946**

LAST year the electrical industry made as good a showing as any in the export field, in spite of the urgent need for electrical equipment at home. Statistics for 1946 are reproduced in another part of this issue and it will be seen that the value of electrical exports reached nearly three times the 1938 figure. Even if it be assumed that prices have doubled since then (and this is a generous allowance) exports must have been 50 per cent over the 1938 volume. Examination of the table of destinations of exports, however, shows only too clearly the fact that we are at present enjoying the benefits of a "sellers' market." Many countries (mainly European) which were poor customers before the war have taken large quantities of our electrical goods. On the other hand the more valuable Latin American markets, although credited with larger values, have obviously been importing smaller volumes of our goods.

**Rising Demand**

AMERICAN electrical utilities seem to "view with alarm" the increasing public demand upon their systems in view of the difficulty of obtaining equipment to meet it. In a reference to British load-shedding, the *Electrical World* (New York) suggests that these growing load symptoms may be international in scope and says "it is more than barely possible that the public has just begun to go electric" after two decades of promotional effort. Our contemporary deprecates (as we do) the attitude of "We have plenty of load, why push for more?" but here, anyway, circumstances are at present too much for us and we can only endeavour to keep the all-electric idea alive until the time comes when development can be vigorously resumed.

# Motor Installation and Maintenance—I

## Foundations and Attention to Bearings

By "Rotor"

WHERE an electric motor is to be mounted at ground level a good concrete bed is advisable. Assuming the concrete can be carried down to well-packed subsoil, a thickness of 3 to 4 in. is suggested for motors up to about 10 H.P., 6 to 8 in. for 10 to 25 H.P., 8 to 10 in. for 25 to 50 H.P., 10 to 15 in. for 50 to 75 H.P., and 15 to 24 in. for 75 to 100 H.P. Where shock loads or very high belt pulls are encountered the thickness of the bed should be increased. For overhead drives motors up to about 50 H.P. may be bolted to strong timbers well supported and secured to walls and/or floors of buildings, although structural steelwork members usually provide better supports.

The motor pulley or pinion should be fitted as close as possible to the bearing in order to avoid excessive bending moment on the shaft. Where a motor drives through the medium of fast-and-loose pulleys, the fast pulley should be nearest the bearing; otherwise the shaft is subject to maximum bending moment when the twisting torque is at a maximum, possibly resulting in damaged bearings and broken shafts. An outboard bearing is advisable for belt and chain motors over about 75 H.P., so that the motor shaft is supported on both sides of the pulley or sprocket. Similar remarks apply to rope and gear drives.

The pulley should be correctly balanced to avoid vibration; it is good practice with a flat belt to limit the diameter of the larger pulley to not more than six times that of the smaller one with pulley centres not less than four times the diameter of the larger pulley. This ensures an adequate angle of belt lap round the smaller pulley. A larger ratio and shorter centre distance can be adopted if a jockey pulley is employed (Fig. 1). Should either of these alternatives be impracticable for a particular drive, the problem can usually be solved by using vee belts. If at all possible the slack side of the belt should be on the top; vertical-belt drives are to be avoided as they tend to slip unless belt tension is excessive. The joints in the belts should be cut square and a smooth fastener employed; belt speeds should not exceed 4,500 ft per min. The motor shaft must be level and in correct alignment with the driven shaft, otherwise vibration and other troubles may be experienced.

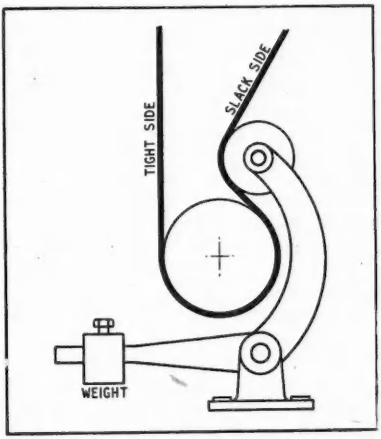



Fig. 1.—Use of jockey pulley on short centre high-ratio belt drive

Where dirt or other foreign matter is liable to find its way into a motor, the installation of enclosed, enclosed-fan-cooled or pipe-ventilated machines should be considered, as cleaning may be almost impossible without incurring inconvenience and expense in dismantling. Motors installed in inaccessible positions tend to be neglected. They do require a certain amount of maintenance even under the best conditions, if only cleaning and lubrication, and facilities should be provided to enable this work to be carried out conveniently.

A motor that is too large for its drive may run with an appreciable reduction of power factor (Fig. 2); if too small it is likely to run at a high temperature with a consequently shortened life, also its speed may be lower than anticipated. Makers of process plant can usually supply information regarding the power required to drive their machinery, but allowance should be made

for any alteration of the loading conditions. Where more than one drive of a particular type is employed, one motor can be temporarily tried on normal load first. The current input to the motor can be measured by a clip-on ammeter and the actual horsepower calculated.

Periodic examination should be made so that any defective parts can be renewed in time to avoid a stoppage. To do so does not involve much time when the person appointed is competent to assess the condition and probable life of the various components. Usually careful inspection about every six months will be sufficient, in addition to normal attention to oiling and cleaning.

Bearings are the only parts of squirrel-cage polyphase motors that are subject to normal wear and should be checked. The only provision for adding lubricant to enclosed ball and roller bearings is by removing the caps. In other cases a Stauffer lubricator or a grease-gun nipple may be fitted. It is often difficult to determine the quantity or state of grease in a ball or roller bearing. Usually the original grease packing will be serviceable for about a year, after which a small quantity may be added about every six months. It is good practice to wash out with petrol the old grease about once every three years, the bearing being allowed to dry before the labyrinth grooves in the caps are repacked and the bearings filled about seven-eighths full with new grease; overheating of ball or roller bearings is usually due to excessive grease having been forced in. Such bearings must be quite free from grit and in dirty positions are likely to require more frequent attention.

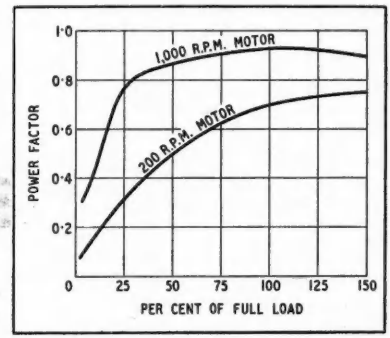



**Fig. 2.—Power-factor curves of typical three-phase, 50-cycle induction motors**

The wear of ball or roller bearings cannot be measured directly, although it can often be estimated by removing the belt or other driving medium and levering the shaft up in its housing to find the amount of play. There should be no appreciable radial play in a well fitting bearing of this type. Another method is to pass long feeler gauges through the end shields and radial air gap between stator and rotor at three or four points round the rotor. The air-gap clearances should be recorded for comparison with previous and future measurements at the same points.

Clearances round the rotor may be unequal due to inaccurate construction, loose bolts in the end shields, bent shaft, foreign matter in the air gap or on rotor or stator cores, damaged core stampings, loose rotor core or worn or loose bearings. A further set of air-gap measurements taken with the rotor turned to a new position may be necessary to check for a bent shaft or deposit on the rotor core. Radial air-gap measurements may give misleading results where a vertical-belt drive is used, as the shaft may rise when running and cause wear on the top side of the bearings. However, such measurements are often of considerable assistance in deciding whether a bearing should be opened up for further attention. Worn ball or roller bearings often (though not always) give notice by noisy running.

It is not advisable to remove a ball or roller bearing from its shaft unless it is intended to renew it. At any time when a motor is dismantled the bearings should be washed out and carefully examined for cracks or chips in the faces of the balls, rollers or races. They should revolve smoothly without catching and any that show the slightest defect of this nature should be renewed. Bearings sometimes creep on the shaft or in the housing, as indicated by polishing, burnishing or scoring at the rubbing surface, a frequent cause being periodic vibration due to faulty gears, heavy belt fasteners or revolving masses out of balance. The cause of creepage should be investigated and removed. If the shaft or housing has become worn it may be possible to fit oversize bearings, or it may be necessary to bore out and bush the housing or renew the end shield, or to build up or bush the shaft or fit a new shaft. Ball and roller bearings should be a press fit on the shaft and a push fit in the housings.

Sleeve bearings should always be checked for temperatures by hand under running

conditions. Oil rings or other lubricating system should also be inspected; excessive lubrication is liable to get on to the motor windings. Wear on the bearings can often be measured directly by passing feeler gauges between the shaft and bearing; where this is not practicable, the radial air gaps and/or lift of the shaft may be checked as for ball and roller bearings. Any worn bearing should be renewed in good time.

Wear or overheating of sleeve bearings may be due to using the wrong grade of oil, dirty oil, insufficient oil (possibly due to leaking oil gauge, overflow, drain plug or cracked oil well), the motor being out of line, excessive belt pull, bent or scored shaft, rough bearing, bearing out of position, oil ring sticking, either due to dirt or other foreign matter or to the ring having parted at the joint or not being truly circular. Overheating may also occur owing to the bearing oil grooves or gutters becoming choked so that heated oil cannot escape freely. In some cases the securing bolt of a bearing has become slack and allowed the bearing to move and trap the oil ring.

A waste-packed bearing housing having no oil rings is often used with smaller motors (Fig. 3). It is wise to renew the packing about every four years as it may settle down out of contact with the shaft in time. Good quality woollen waste, well soaked in oil and drained before packing, should be employed.

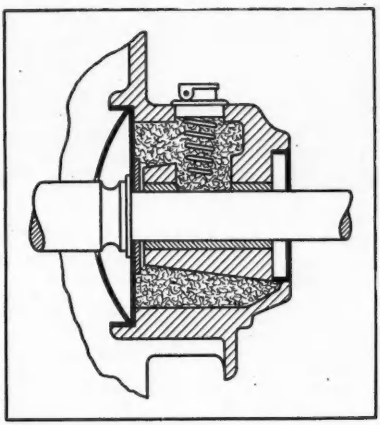


Fig. 3.—Section of waste-packed bearing housing

Should a sleeve bearing be so hot that seizure appears imminent the motor should be kept running, the speed being reduced if possible, the load taken off, and belt removed or slackened, whilst oil is poured copiously over the bearing. The motor should not be stopped until the temperature of the bearing is low enough for it to be touched by hand.

# Picture Transmission

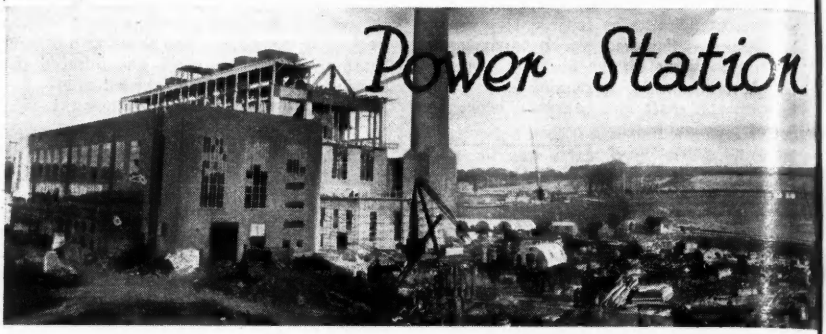
## Equipment in H.M.S. *Vanguard*

FACSIMILE photo-telegraphy equipment has been installed in H.M.S. *Vanguard*, in which the King and Queen are sailing to South Africa this week, to enable Press pictures to be radio-telegraphed from the battleship to England during the voyage.

The equipment was designed and made by Muirhead & Co., Ltd., at the request of the Admiralty. Two transmitting assemblies with associated electronic apparatus are mounted on three racks, one being a stand-by set which can alternatively be used as a monitoring receiver. The system utilizes sub-carrier frequency modulation and works straight into the normal amplitude-modulated ship's radio transmitter.

A picture measuring 8 in. by 5 in. may be sent in about 12 minutes, reception in England being arranged by the G.P.O. and Cable & Wireless, Ltd. The outfit is basically of the Muirhead-Belin type (*Electrical Review*, June 14th, 1946, p. 931) and its makers propose to proceed with its manufacture as a standard product for installation on large vessels having suitable radio equipment.

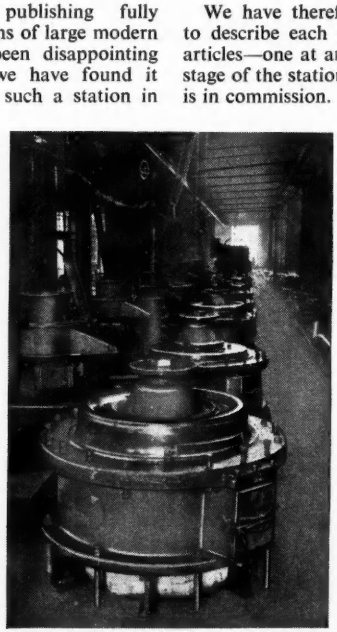
H.M.S. *Vanguard* has been equipped with a long-range duplex radio transmitter, type DS.10, made by Standard Telephones & Cables, Ltd., as usually fitted in large liners. The set will enable telephone calls to be made through any exchange in Britain or South Africa and programmes from the battleship to be broadcast from any station in either country. Electronic keying will also permit telegraphy at 600 words per minute with two channels of 5 kW each or three of 3 kW each, the frequency range being 2·5 to 22 Mc/s. The valves are cooled by air blast from three blowers, the whole assembly being accommodated between decks in four cabinets bolted together and measuring only 6 ft 6·5 in. high, by 9 ft 3 in. long, by 3 ft 2 in. deep.




## Particulars of Layout and Erection of the Initial Stage (120,000 kW) the North-West Midlands Joint Electricity

PREPARING and publishing fully illustrated descriptions of large modern generating stations has been disappointing to us of late, because we have found it unsatisfying to deal with such a station in one article at what has been generally considered to be the best time for such a task, i.e., a short while after the station has been put into commission. The modern large power station is a rather intricate affair (although the expert may not at first be inclined to agree) which is viewed broadly from two different angles — constructional and operational—by the two engineering sections which are mainly concerned.

After the station is commissioned there is a strong tendency to see the station only from the operational viewpoint, and the subjects which make the best pictures in the finished station are generally not very informative constructionally because of the trend nowadays to " box-in " everything and to include as much as possible in each box.



**Some of the pulverizing mills have already been installed**

We have therefore decided to endeavour to describe each new power station in two articles—one at an interesting constructional stage of the station and one when the station is in commission. In this, our first post-war description on these lines, we deal, mainly constructionally, with the new Meaford power station of the North-West Midlands Joint Electricity Authority, which is now in a fairly advanced stage and is designed to supply to the grid direct at 132 kV through six feeders.

The station represents the first phase of a project which visualizes two entirely separate stations on a common site. It is to be a complete station with a main plant capacity of 120,000 kW, consisting of four 30,000-kW G.E.C. turbo-alternators served by six Babcock & Wilcox 240,000 lb per hour boilers which discharge into two 320 ft high chimneys. Although both in construction and operation the present and later stations will be entirely separate units, certain site features will be common to both.

# Construction

## of the Meaford Scheme of Authority

The present station is to be complete from the start; there will be no division of the plant sections in respect of time developments or by way of extensions. Work on all the plant and buildings is going ahead now. There will, however, be progressive commissioning of the plant now under construction and erection. For instance, the first turbo-alternator is expected to be put on commercial load about June next, the second about July, the third about November, and the fourth set approximately in January, 1948.

The station is situated about six miles south of the city of Stoke-on-Trent, near the village of Barlaston, between the L.M.S. Railway and the Trent and Mersey Canal on the north-east side and the main Stoke to Stafford Road on the south-west side. It is essentially served by rail-borne coal, the station sidings being connected with the L.M.S. line at Barlaston, although emergency provision is made for receiving coal by road. The boilers are fired with pulverized fuel.

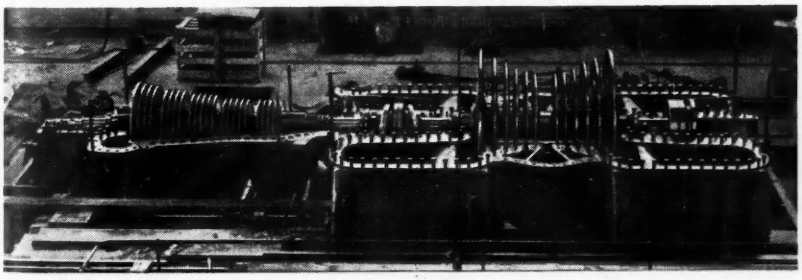
Visualizing the site as limited to the layout of the present station, the coal store lies at the east corner. It is almost semi-circular in shape, with a radius of about 550 ft, the curved western part being bordered by rails to accommodate the reclaiming and distribution equipment. Most of the north-east side of the store is bordered by the station railway sidings. In the opposite or west corner of the site is the grid outdoor substation which will house the 132-kV switchgear and the main generator step-up transformers. This rectangular compound runs end-to-end north-west and south-east, and almost in line with it at the south-east end are the two station cooling towers which are also almost centrally south-west of the coal store.

**Station and coal-storage ground, showing first and second coal-receiving points**

### Lay-out of Buildings

About 200 ft north-east from the grid substation and parallel with it is the turbine house measuring about 370 ft long, 90 ft wide and 72 ft high. The four turbines are to be arranged in end-to-end alignment. On the south-west side of the turbine house is an annexe which is designed to accommodate the feed-water pumps and feed-water heaters.

Adjacent to the turbine house on the north-east side is the boiler house which is about 280 ft long, 100 ft wide, and 104 ft high to the main roof above which rises the coal conveyor house over the coal-bunker bay on the south-west side of the boiler house. The six boilers stand side by side in a single row. To the north-east of and parallel with the boiler house is the building

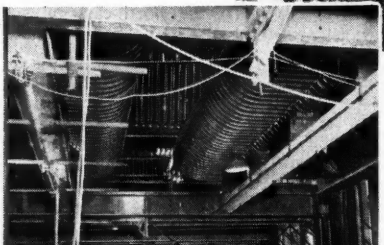


**The most advanced turbine has its blading in position**

which will house the electrostatic precipitation plant for cleaning the main flue gases. This building is about the same length as the boiler house, and near each end of it is one of the station chimneys which are arranged symmetrically with the main buildings. Between the grid substation and the turbine house are buildings which will accommodate the operating room on the top floor of the offices and workshops. There will be a footbridge for the purpose of providing communication between the operating room and the switchgear annexe and turbine house.

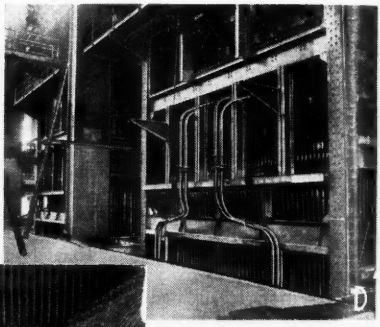
The site sub-soil is clay which had to be thoroughly piled. Franki piles, which are cast in position by ramming fairly dry concrete into steel tubes driven into the soil, are used, and there are about 4,000 of these, from 20 ft to 30 ft long. Beams varying in thickness from 4 ft to 6 ft rest on the piles and carry reinforced concrete slabs between them. This system of piles, beams and slabs forms the general foundation for the buildings, but there are separate foundation blocks for the main building columns. The boilers are supported on steel frameworks, each quite independent of the steelwork of the main building structure.

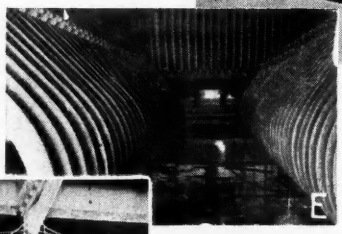
The turbo-alternators have foundation blocks which are also independent of the general foundation system and therefore of the buildings it carries, and there are no connections between the floors and turbo-alternator blocks. The buildings have steel-frame structures which carry the whole of the weights superimposed on the upper floors. The walls are of sand-faced brick. The roof of the turbine house is constructed of Siegwart pre-cast hollow reinforced-concrete beams, grouted and asphalted, while the roofs of the other buildings are constructed of reinforced concrete cast *in situ*. Each chimney stands on a square base, and the complete structure has a sand-faced brick shell and an acid-resisting "Nori" brick lining. There is a 2-in. cavity between the shell and the lining.


F

### Coal-handling Equipment

Two coal-receiving points on the railway sidings serve the coal-handling and storage systems. One of these receiving points is outside the storage ground and directly in line with the centre line of the boiler house.


D

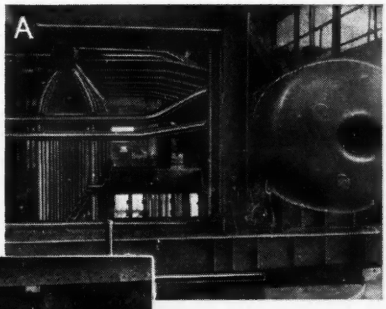

E

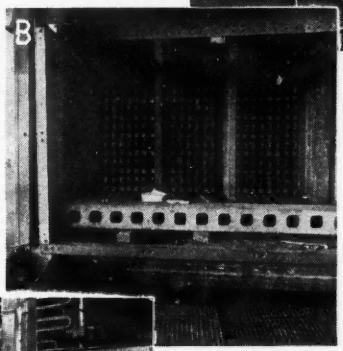
The other is at the radial point of the semi-circular storage ground. From the first receiving point the coal will be discharged from 20-ton trucks by a combined side-discharge wagon tippler and automatic weigher into a reinforced-concrete hopper whence it will be elevated to the conveyor house over the boiler bunkers at a level of about 30 ft above the main boiler house roof. Distribution to the six bunkers will be effected by two shuttle conveyors running longitudinally along the conveyor house and thence to the boiler house.

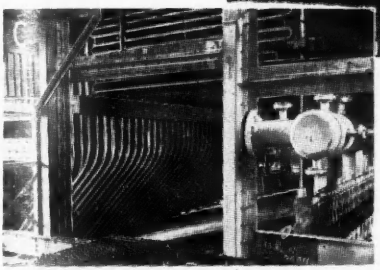
The rising conveyor plant will embrace a magnetic separator and automatic coal-sampling equipment. This direct coal-handling plant is designed to deal with 150 tons per hour. Washed Staffordshire

stocks are to be consumed, and for the purpose of overcoming possible "stacking-up" difficulties which may be encountered each of the boiler house bunkers is provided with a section for dried coal.

At the storage ground receiving point the discharge equipment and arrangements will be similar to those at the first point. The coal will be removed from the hopper by a feeder and gravity bucket conveyor to a radial boom conveyor by which the coal will be deposited on an initial pile from which the fuel will be distributed over the storage area by a drag-scraper. This will also serve for reclaiming purposes, the coal being first brought to the receiving hopper at the storage ground and then conveyed to the first receiving point. The storage ground handling system is also designed to deal with 150 tons per hour. Like the storage ground, the second receiving point will be common to both stations. The whole of the coal-handling system is being installed by Babcock & Wilcox, and it will include a Fraser & Chalmers drag-scraper.



**Immediately after the completion of the boiler tube work: A, drum and tubes to circulating system; B, high-temperature economizer; C, circulating system and part of superheater; D, welled arch at top of combustion chamber for p.f. burners; E, outlet at bottom of combustion chamber; F, ash-hopper gallery immediately under combustion chambers**

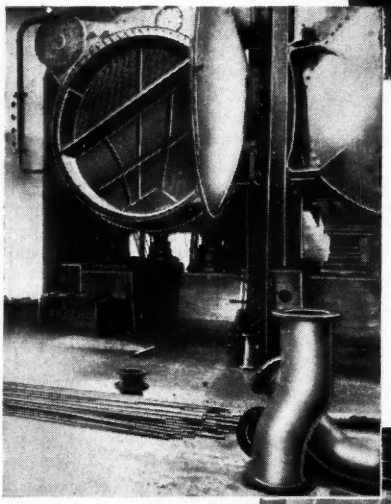
Each of the Babcock & Wilcox high-head type boilers for pulverized-fuel firing has an output at the economic rating of 192,000 lb per hour (240,000 lb per hour m.c.r.). The superheater outlet steam conditions are 650 lb per sq in. and 850 deg F. The boiler structure rises from the basement level to a height of a little above 85 ft, the approximate centre level of the steam drum which is 5 ft in diameter. About 5 ft below the bottom of the drum, to the front of the drum centre line, is the high-temperature economizer immediately in front of which are the h.t. (top) and l.t. superheater sections constituting a continuous-loop single-pass equipment. The bottom of the lower superheater section is approximately 68 ft from the basement level. Immediately below the superheaters is the circulating system with its tube bank rising from the back to the front headers at an angle of about 22 deg from the horizontal.

From its necked bottom, which is about 13 ft from the basement level and feeds the ash hopper below, the combustion chamber rises to the circulation system to a height of about 44 ft along the centre line. From back to front the combustion chamber measures about 24 ft and its side-to-side dimension is about 22 ft. At the front the top 12 ft or so of the combustion chamber wall is welled or arched inwards to the extent of about 6 ft, and the bottom of this recess forms the furnace arch which carries the nine boiler burners.

About 8 ft below the bottom of the burner arch is the boiler operating floor. The nine burners are served directly from three Babcock & Wilcox "Type E" pulverizing mills, three per boiler, which are all aligned

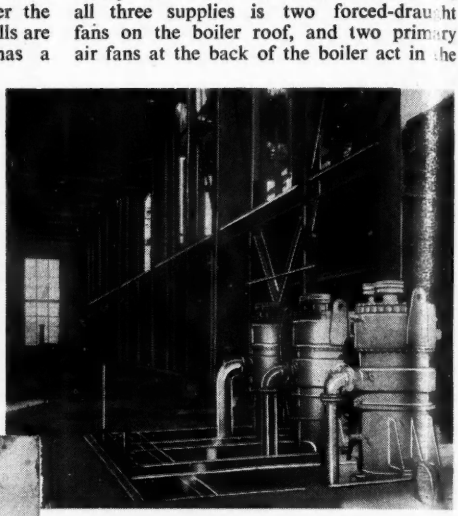
at the basement level in the mill bay at the front of the boiler and directly under the main boiler bunkers from which the mills are directly fed. Each of the mills has a capacity of 5 tons per hour. The bottoms of the bunkers are about 70 ft from the basement level and they extend upwards to the conveyor house on the boiler house roof.

There are three supplies of air for combustion. Primary air is taken from the primary air heater, at the back of the boiler and about 55 ft above the basement, and passed on to the combustion chamber via the mills. Secondary air is taken from the secondary air heater, at the back of the primary air heater, and



**The condenser of the most advanced set is on its plinths; other plinths are ready to receive the condensers**

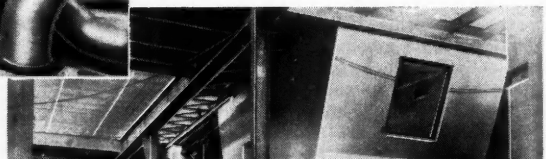
passed to the combustion chamber through the annular spaces at the burners. Tertiary air is taken from the secondary air ducting and passed to the combustion chamber through ports in the furnace water - cooled Bailey walls. The main source of air for all three supplies is two forced-draught fans on the boiler roof, and two primary air fans at the back of the boiler act in the



**Feed-pump annexe showing pump sites only; h.p. feed heaters on right**

nature of a boost in a by-pass of the main air system.

The gases pass up from the combustion chamber through the circulation system and the two superheater sections, and then down through the primary air heater and the low-temperature economizer which is directly under the primary air heater, and up again through the secondary air heater, at the back of the primary air heater and low-temperature economizer, on to the electrostatic precipitator, then to two induced-draught fans

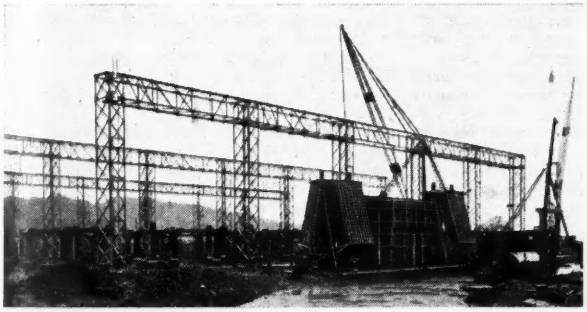


at ground level between the secondary air heater and the Lodge-Cotterell precipitators, and finally to the main flue and the chimneys. The ashes from the boilers are disposed of by a sluice system.

### Turbo-alternator Plant

Each of the four turbo-alternators has an economic output of 24,000 kW (30,000 kW m.c.r.), and the stop-valve steam conditions are 600 lb per sq in. and 825 deg F. Each turbine has two cylinders with a double-flow low-pressure cylinder. There are 24 high-pressure stages and six stages in each of the l.p. cylinder "flows." Steam is bled from the turbine at four points for feeding, in order of bled temperatures, l.p. and i.p. feed-water heaters, a unit evaporator and a h.p. feed-water heater.

There are five electrically-driven and three steam-driven (stand-by) feed-water pumps in the pump annexe to the turbine room, and operationally they are connected in the heat-cycle between the l.p. and i.p. feed-water heaters which are situated in the condenser basement. The h.p. feed heaters are in the pump annexe at the same level as the turbine operating floor, about 24 ft above the base-



The first generator transformer has been received at the grid substation

ment level. Feed-water make-up will be provided from the town supply, by way of a storage tank under erection at Bury Bank about four miles away, or pumped from a near-by brook, and it will go through a Kennicott water-softening plant before being passed to the evaporators. In addition to the unit evaporators there is a central evaporating plant fed from the steam range and designed to supply 10,000 lb of distilled water per hour continuously.

Each turbine exhausts into Hick Hargreaves

Work on the cooling towers is very advanced; c.w. pump house at foot of right tower

twin condensers designed to maintain an absolute pressure of 1·8 in. Hg. when dealing with 213,000 lb of steam per hour with specified circulating water conditions. Each unit is served by two "Hi-Vac" extraction pumps and two air ejectors, all situated in the condenser basement. The circulating water is to be dealt with by five Allen centrifugal pumps in a pump house adjacent to the cooling towers. The pumps discharge into a ring main culvert from which delivery tappings are taken to the four sets of twin condensers. The discharge from the condensers is taken through another culvert system and rises to the cooling tower distributing stacks.

Each of the two Davenport hyperbolic concrete cooling towers is designed to deal with 3,000,000 gallons per hour cooled from 82·5 deg F to 70 deg F. The towers are 250 ft high and have a base diameter of 190 ft. The two tower ponds are separated to facilitate cleaning, and the ponds discharge into a common flume from which the c.w. pumps draw their water.

Make-up for the circulating-water system will be provided by the effluent from the sewage works at Strongford, about 1¾ miles from the station, and in order to meet this demand of three million gallons per day the sewage works is being extended by four

more humus tanks, and a pump house is being built at Strongford, which will accommodate four Allen pumps, each to handle 2,750 gallons per minute.

The alternators will generate at 11·8 kV, and each will be connected through a G.E.C. metalclad drop-down vertical circuit-breaker to a 33,000-kVA, 11·8/132-kV G.E.C. transformer. All these main transformers are to be situated in the grid substation, and the main operational switching for the alternators will be carried out at 132 kV by remote operation. All the station auxiliaries, with two exceptions, are to be supplied at 400 V; the feed-water and circulating-water pumps will be driven by 3,000-V motors.

The civil contracting work at the station is being carried out by G. Percy Trentham, Ltd. The station has been designed by and is being erected under the supervision of Merz & McLellan, consulting engineers, in collaboration with Sir Alexander Gibb & Partners on the civil engineering side, and under the direction of Mr. F. Favell, chief engineer and manager, North West Midlands J.E.A., to whom we are indebted for the co-operation of his staff in the preparation of this article and for permission to publish it.

# Portsmouth Apprenticeship Scheme

### Training Meter Mechanics and Electricians

WITH the prospect of a considerable decrease in the supply of young workers and other newly trained entrants into industry during the next few years, increasing interest is being taken in training schemes for apprentices. That introduced by Portsmouth Electricity Service (Corporation Electricity Department) provides for the selection of apprentices by examinations set by the Education Department, a probationary period of one month, a term of five years, attendance at classes at the local Municipal College on two afternoons and three evenings a week, and wages appropriate to the trade or industry in which the apprentices are engaged. A training supervisor has sole authority over the apprentices and students.

During the first month students are introduced to the new sphere of life by lectures given by officials in all departments. During this introduction the boys have an opportunity to make up their minds as to the trades they prefer.

Two schedules, one for the meter department and one for electricians, have been drawn up, which ensure that all aspects of the various trades are covered adequately in the set time.

Under the meter department schedule the first year is spent mainly on painting, wiring and sealing, records and repairing meters. The second year covers such matters as meter fixing, wiring and assisting in testing new meters and meter repair and overhaul. The whole of the third year is spent in overhauling instruments and time switches. During the first half of the fourth year apprentices visit manufacturers, undertakings, H.M. Dockyard and the Municipal College, while the remainder of the year is devoted to instrument testing. The final year is given to testing, potentiometer, standardization, calibration and overhaul of attachments, and the last four months to specialization in a particular trade.

The electricians' training schedule provides for installation of cookers and water-heaters, plumbing, meter fixing, testing, etc., during the first year. The second year is spent on reconditioning of domestic appliances and outside maintenance with electricians. In the third year the apprentice is introduced to cable jointing and the meter testing and street lighting departments, while the fourth year is divided between the generating station and visits to other undertakings or companies allied to the supply industry. The last year is spent in the motor shop and in specialization as considered necessary.

Facilities exist for the exchange of apprentices in similar trades between various Corporation departments. The avenues of progress to studentship in electrical and mechanical engineering and graduateship of the professional institutions are open, and every boy has facilities to enable him to progress to the limit of his capabilities.

An apprentices' society has been formed which aims at promoting unity amongst the boys, giving them a sense of responsibility in running their own affairs and providing opportunity for cultural activity. A scheme is also in operation for the boy who has taken a full time college course in electrical or mechanical engineering and enters above the age of nineteen years.

## French Railway Electrification

AMONG the works planned in France is the electrification of the railways south of Paris. This is the link between the West, South-West and East sections of the S.N.C.F., and the plan envisages the electrification of a part of the Versailles-Sucy line, via Massy, Savigny, Juvisy and Valenton, and also the line between Massy and Orly, the direct connection between Versailles and Valentin. The plan would greatly accelerate traffic on these lines, both passenger and goods services being improved. It would also be of the greatest importance in view of the future development of the Orly airport.

# Commissioners' Report

## Record of the War Years

IN their Twentieth Report, which covers the years 1939-40 to 1944-45 (Stationery Office, 10s. net), the Electricity Commissioners have included the material which but for security reasons would have been published annually. After briefly indicating the position of the electricity supply industry immediately before the war, the Report deals with the more important factors, including civil defence, that affected it until the end of hostilities in Europe. This section occupies 46 of the 196 pages of the document, the remainder being allocated to the features to be found in the earlier Reports relating to technical, legal, statistical and general administrative matters and sixteen appendices.

### Damage by Enemy Action

Of the total number of power stations in operation, which varied from 365 to 345, 65 suffered from enemy action, fifteen in a minor degree. Of the 50 which sustained heavier damage, only 38 (3,275,000 kW installed) were in Southern England. No more than 266,000 kW of generating plant (all in five Greater London stations) was out of commission at the end of any month (October, 1940) of the worst period, while the maximum temporary loss of output to the grid did not exceed 400,000 kW throughout the war. In many cases there was no interruption in supply to consumers and in others supply was quickly restored by bulk supplies from the grid, often by the use of the national reserve of emergency equipment. Enemy action caused 52 deaths and 91 injuries at power stations.

The Central Electricity Board's system sustained 2,519 war-caused breakdowns, but only 666 resulted in supply interruptions of above one hour and in 985 cases there was no interruption. On 365 other supply systems affected by hostile action, the corresponding figures were 3,667, 2,357 and 245 respectively. Of the 6,186 war-faults on all systems, about 42 per cent were caused by drifting barrage balloons. The cost of war damage amounted to £10·2 million, of which £8·9 million was incurred by 44 undertakings.

At the end of the war there were 570 authorized undertakings (eleven fewer than in 1939) comprising the C.E.B., the North of Scotland Hydro-Electric Board, three Joint Electricity Authorities, five Joint Boards 365 local authorities and 195 companies. In 1939, 365 stations (having a total capacity of 8,658,000 kW) generated 26,409 million kWh and in 1944, 345 stations (11,254,000 kW) generated 38,363 million kWh—an average annual rate of growth of 9·5 per cent (due mainly to power supplies). The consumption of coal (which produced about 96·5 per cent of the output) went up from 15 million to 23 million tons, an average annual rate of growth of 10·9 per cent, giving 1·4 lb per kWh generated as against 1·35 lb in 1939. If the latter figure had been maintained throughout the period, some 4 million tons of coal (with attendant transport and ash disposal would have been saved) or enough to have generated 6,560 million kWh. Eighty stations were responsible for 91·7 per cent of the total output. Particulars are given of the annual output of power stations of railway and tramway authorities: nineteen stations generated 1,286 million kWh in 1944 for 963,000 tons of coal.

### New Plant Sanctioned

Only 141 of the stations referred to are "selected stations" but 48 others are operated under the directions of the C.E.B.; in 1944 these together produced 99·0 per cent of the electricity supplied by authorized undertakings, exclusive of those in North Scotland. Between 1941-42 and 1943-44 up to 292,000 kW was exported from S.E. England Area to S.W. England and South Wales, which necessitated a substantial reinforcement of the grid. Sanctions were given during the period to the installation of 3,065,000 kW of new plant (575,000 kW in eight new stations) of which all but 83,000 kW was for selected stations.

In 1940, the revenue of authorized undertakings for the first time exceeded £100 million; by the end of 1944 the amount had risen to £142 million. The average revenue per kWh sold for all purposes in 1944-45 was 1·07d. per kWh, compared with 1·04d. in 1938-39; for power, the comparative figures were 0·88 and 0·66d. and for lighting, heating and cooking 1·56 and 1·60d.

C†

The most important purpose for which borrowing by local authority undertakings was sanctioned was power stations, which accounted for the major portion of £77·5 million passed for buildings, civil engineering work and plant out of a total for all purposes of £102·7 million (including £19·8 million for the C.E.B.).

In giving consent to changes of voltage or type of current the practice of the Commissioners is to stipulate that the undertaking shall either alter consumers' apparatus appropriately or shall bear the cost of the alteration. Particulars are given of a case in which the arbitrator found that the substitution of a valve rectifier for a motor-generator which was used for charging batteries did not meet requirements in the circumstances.

### Multiple Earthing

The Commissioners gave approval to the connection of two low-voltage and seventeen high-voltage systems to earth at more than one point. In view of wartime restrictions upon normal electrical developments in rural and other areas, the Commissioners deferred settlement of the form of approval and special regulations in regard to multiple earthing, which has been the subject of two E.R.A. Technical Reports. Reference is made to the modified requirements in respect of high-voltage overhead lines affording supplies in rural areas and to a new type of line (which has subsequently been covered by B.S. 1320—1946). Special regulations were made in eighteen cases permitting undertakings to insert arc-suppression coils in high-voltage earthing connections. A legal case which called in question the validity of two-part tariffs (Attorney-General *v.* Wimbledon Corporation) is summarized. The claim that such a tariff was *ultra vires* was rejected, but the Court held that a fixed charge imposed on any such vague basis as size and type or nature of electrical demand was bad.

In the three years preceding the period covered by the Report the number of applications for consent to the erection of overhead lines averaged 4,600 per annum, whereas the total for the subsequent six years was only 11,038, nearly one-third of which were made in 1940. An important judgment on the right of an undertaking (the C.E.B.) to retain its lines over land (under Section 11 of the Act of 1922) after termination of a way-leave agreement is referred to in some detail, the upshot being that the undertaking was held not to be trespassing.

Towards the end of the war the Commissioners were asked by the Government to indicate the nature and extent of schemes which the supply industry would wish to carry out as soon as circumstances permitted. Capital expenditure during the first five post-war years was estimated at £155 million for generation and £227 million for other works.

The number of employees of electricity undertakings at March 31st, 1939, was 122,237 (114,904 male) of whom 21,068 were engaged in generation, 73,623 in transmission and distribution and 27,546 in other ways. Losses owing to releases to the Forces or transfer to other industries aggregated 37,392 and those due to deaths and retirements to 39,229; new employees numbered 46,079 (33,578 male). The total at January 1st, 1944, was 91,695 (77,194 male), of whom 26,301 were at power stations, 42,749 on the mains and 22,645 on other work. Administrative expenses of the Commissioners amounted to £54,600 in 1940 (0·65d. per 1,000 kWh sold) and to £72,370 in 1945 (0·56d.).

## New Books

**Factory Management.** By P. H. Billington. Pp. 111. Emmott & Co., Ltd., 31, King Street West, Manchester, 3. Price 3s. 6d.

This is one of the *Mechanical World* monographs and forms a useful general guide to the administration and organisation of an industrial establishment. It covers such matters as organisation of a sales department; selection and layout of plant; design and drawing office procedure; estimating and rate fixing; tools and gauges; production control; purchasing; records; and labour control.

**Advertising : Purpose and Design.** By Maurice G. Frost (32 pp.). Fitzroy Publications, 54, Grafton Way, London, W.1. Price 2s. 6d.

In a brief compass this booklet effectively puts forward the principal matters to be considered in employing various forms of advertising —Press, circulars, letters, posters and other media. Space buying, selection of type faces, block-making, the use of colour and market research are among the points touched upon and at the end are a selection of books of reference, a glossary of terms and examples of type.

**Inventions, Patents & Monopoly.** By P. Meinhardt. Pp. 352; index. Stevens & Sons, Ltd., 119 & 120, Chancery Lane, London, W.C.2. Price 25s.

# PERSONAL and SOCIAL

## News of Men and Women of the Industry

ON January 25th, **Professor M. G. Say**, Ph.D., was installed as the new president of the Watt Club at the Heriot Watt College, Edinburgh. Instituted in 1854 to do honour to the memory of Watt, to promote the interests of the Heriot Watt College, and reward distinguished students in engineering, the club has many well-known names on its roll. Following the installation ceremony Professor Say delivered an address on the work and discoveries of Watt and Faraday.

**Dr. J. E. Richardson**, at present principal of the Royal Technical College, Salford, has been appointed principal of the Northampton Polytechnic, St. John Street, London, E.C., in succession to **Mr. S. C. Laws**, O.B.E., M.A., M.Sc., who will retire at the end of March after twenty-two years' service. Before taking up his present appointment at Salford, Dr. Richardson was principal of the Municipal Technical College, Oldham, and from 1933 to 1941 he was on the staff of Hull Municipal Technical College, first as chief lecturer in electrical engineering and later as head of the Engineering Department. He holds the degrees of Ph.D. and B.Eng. of Liverpool and is a member of the Institution of Electrical Engineers and an associate member of the Institution of Mechanical Engineers. Dr. Richardson takes up his new appointment on April 1st.

Dr. J. E. Richardson

Mr. S. C. Laws

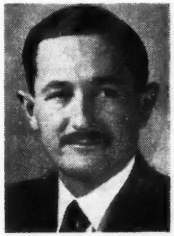
Mr. Laws took his degree course at the University College, Nottingham, where he graduated in physics with honours and was awarded a scholarship to St. John's College, Cambridge University, where he subsequently carried out electrical research in the Cavendish Laboratory under the late Prof. J. J. Thomson. He was awarded the B.A. degree and the University Certificate for distinguished research work. Mr. Laws proceeded to King's College, London, where he obtained his M.Sc. degree. In 1905 he was appointed lecturer in physics at King's College and in the following year head of a department at Blackburn Technical College. His next post was as principal of the Loughborough Technical Institute (now Loughborough College) which he held from 1909 to 1915, and during the next nine years he was principal of the Mining and Technical College, Wigan. He became principal of Northampton Polytechnic in 1924. Mr. Laws served on the Percy and Burnham Committees.

**Mr. A. Tustin**, M.Sc., M.I.E.E., whose appointment as Professor of Electrical Engineering at Birmingham University we recently reported, received his technical education at King's College, University of Durham, and his training with the Metropolitan-Vickers Electrical Co., Ltd., with whom he subsequently became assistant chief engineer at the Attercliffe Common works. From 1934 to 1937 he was engaged by the Soviet Government as consulting engineer to the Moscow Dynamo Works.

A. Reyrolle & Co., Ltd., announce the following appointments in their Southern Area organization: **Mr. N. V. Castling** becomes joint Southern Area manager, **Mr. W. H. Gofton** becomes district manager (Holmes Division), and **Mr. A. H. McQueen** becomes district manager, Bristol. **Mr. J. R. Cowie** has recovered from his recent serious operation and has resumed duty as joint Southern Area manager.

At the first annual general meeting of the National Federation of Master Steeplejacks and Lightning Conductor Engineers on January 22nd, **Mr. Donald Campbell** (J. W. Gray & Son, Ltd.) was elected president, and **Mr. A. Beaumont** (F. E. Beaumont) vice-president.

**Mr. J. A. Oldfield**, of Wellington, has been appointed by the Midland Electric Manufacturing Co., Ltd., as the company's representative for New Zealand. Mr. Oldfield, who is a Bachelor of Laws of the University of New Zealand, has just returned to civil life after six years' service with the Royal New Zealand Air Force. He attained the rank of wing commander and was for a period in command of the New Zealand Fighter Wing in the Pacific area. During this service he was awarded the D.F.C. He has spent some considerable time at the M.E.M. factory and will take up his duties in New Zealand on May 1st. He will reside in Wellington and communications may be sent to him at G.P.O.



Mr. J. A. Oldfield

Box 184. Mr. Oldfield will be taking over the duties of **Mr. C. B. Shaw,** who has retired after representing the company for fourteen years.

**Mr. A. J. Minns,** who, as we recently reported, has been appointed managing director of Watson & Sons (Electro-Medical), Ltd., joined the company twenty-one years ago, and after wide experience in various phases of the manufacture of X-ray and electro-medical apparatus, became the company's chief engineer. During the war he devoted his energies to the provision of X-ray equipment for the Forces, and he was also largely instrumental in developing the design of the Watson apparatus for mass miniature radiography which has now been adopted by the Ministry of Health. He succeeds **Mr. G. Pearce** who has retired on medical advice.

Mr. A. J. Minns

On account of ill-health, **Mr. A. G. Bell** left the service of Wood & Cairns, Ltd., at the end of 1946, having been on the staff of their Glasgow branch for twenty-seven years. Before leaving he received a presentation from his colleagues at Glasgow. Mr. Bell was entertained at luncheon by the directors of the company and a presentation was made to him by the managing director. Mr. Bell had served with the General Electric Co., Ltd., for twenty-five years before joining Wood & Cairns.

**Mr. T. Atherton,** managing director of Dorman & Smith, Ltd., and chairman and joint managing director of D.S. Plugs, Ltd., has left this country for South Africa. He expects to be away about three months.

**Mr. K. W. Finch,** B.Sc., A.M.I.E.E., senior technical assistant at Norwich, has been appointed deputy borough electrical engineer and manager at Cheltenham.

**Mr. J. Billcliff,** deputy mains engineer and technical assistant, Cheltenham, has been promoted to technical assistant under the distribution department reorganization scheme.

**Mr. Albert A. Davis** has retired from the position of engineer to the Mexborough & Swinton Traction Co., Ltd., which he has held for twelve years. Before joining the company twenty-eight years ago Mr. Davis had been with the Fellows Wheatcroft Electrical Co., Walsall, the Walsall Electricity Department, and the Brush Electrical Engineering Co., Ltd.

**Sir William Robinson** has been appointed chairman of the Northern Ireland Electricity Board for the ensuing year.

**Mr. N. C. Wick,** who was recently appointed electrical draughtsman with the Borough of Gravesend Electricity Department, took up his new position on January 13th. He was formerly employed as a draughtsman with the West Ham and Southend Electricity Departments.

Aberdeen Corporation Electricity Committee has recommended to the Town Council that the appointment of **Mr. J. E. Whittaker** as assistant electrical engineer be confirmed as from June 1st, 1945.

**Sir Montague Hughman,** the chairman, recently presented long-service certificates to employees of W. T. Henley's Telegraph Works Co., Ltd., who had completed twenty years' service at the head office and works. He has also made special presentations, including books of Savings Certificates, to Messrs. S. E. S. Sellers, J. H. Richmond and B. G. Dixon to mark their completion of fifty years' service.

**Mr. I. A. Marriott** has joined the board of the Brush Electrical Engineering Co., Ltd., as local director responsible for sales. He is already commercial director of Associated British Oil Engines, Ltd.

**Mr. G. Marks,** director of Clayton, Lewis & Miller, Ltd., Southend-on-Sea, has left for the United States in the S.S. *America* to study American design and production methods. He will stay for approximately eight weeks.

**Mr. R. P. Middleton** has been appointed to the board of F. H. Wheeler (Sheffield), Ltd., and **Mr. J. S. Smith** has recently been appointed chief engineer of the company.

**Sir Clifford Paterson** was present at a party given to 700 children (120 from Dr. Barnardo's Home and the remainder belonging to G.E.C. research workers) on January 11th at Wembley by the Research G.E.C. Social Club. The

**Resident engineers of Edmundsons Electricity Corporation, Ltd., and representatives of Ewbank & Partners, Ltd. (consultants to Edmundsons) viewing experimental super-voltage cable installat ons in the H.V. Laboratory at Siemens Bros.' Woolwich works**

highlight was a circus put on by members of the mechanical engineering department. Other attractions were a small-gauge passenger-carrying railway, a film show, a flying model aeroplane and an overhead railway. The children were provided with tea at which they were waited on by the research staff. The principal organizers were Mr. J. S. Willmott and Mr. A. Lindell.

The first post-war staff dinner of Abell and Smith's Electrical Co., Ltd., was held recently at the Guildhall, Worcester, **Mr. H. Horton Smith**, managing director, presiding. In proposing the toast to the company, Mr. G. E. Clarkson, city electrical engineer, referred to the Electricity Bill and said that in spite of the clause relating to the sale, installation and repair of electrical fittings he was confident that the firm would continue to flourish. Mr. Horton Smith, in responding, said that in 1941 the company celebrated its twenty-fifth anniversary and nine staff members completed twenty-five years' service; since then six more employees had completed twenty-five years' service.

Ex-Ferranti men of not less than three years' service are invited to a dinner at the Savoy Hotel, London, on March 11th, to congratulate **Mr. V. Z. de Ferranti, M.C.**, on his presidency of the Institution of Electrical Engineers. Particulars can be obtained from the hon. secretary, Mr. W. E. Warrilow, M.I.E.E., 24, Bath Hill Court, Bournemouth (phone: Bournemouth 4810).

## Obituary

Sir **Thomas Higham, J.P.**, Deputy-Lieutenant and formerly High Sheriff of Lancashire, died on January 22nd at the age of eighty. He was knighted in 1934. For forty-one years he presided over Accrington Electricity Committee and for twenty-five years, up to 1944, he was chairman of the North-Western Industrial Council for the Electricity Supply Industry. He was also chairman of the Mid-Lancashire Electricity Advisory Board for many years.

**Mr. E. F. J. Holcombe Hewlett, M.I.E.E., M.Amer.I.E.E.**—We regret to record the death of Mr. Ernest Frederick John Holcombe Hewlett which occurred on January 22nd at Mansfield, where he was the first borough electrical engineer. Mr. Hewlett, who would have been eighty-one on February 1st, was born in Manchester and served his apprenticeship to the Edison-Swan Co. in that city. Subsequently he held appointments with Baerlein & Co., Lisbon, Siemens Bros., and Hove Corporation. In 1895 he went to Australia as engineer and manager of the Rockhampton Electricity Works, Queensland, where he undertook a complete lighting scheme for the town. Later he designed and carried out a combined lighting, power and traction scheme for the Mount Morgan Gold Mining Co. Returning to England in 1901, he assisted in the preparation and supervision of schemes at Hackney, Dublin and other places. His association with Mansfield began in 1902 as resident engineer for the construction of the works, after which he was appointed electrical engineer, from which position he retired in 1937.

**Wills.**—**Mr. C. Rodgers, O.B.E., B.Sc., B.Eng., M.I.E.E., M.I.Mech.E.**, deputy director of the British Electrical and Allied Manufacturers' Association, who died on November 5th last, left £15,604 gross, with net personalty £13,525.

**Mr. C. H. Stagg**, former electrical engineer with Eston (Yorks.) U.D.C., who died on September 22nd last, left £971 gross, with net personalty £926.

**Mr. F. B. Leonard**, formerly deputy chief electrical engineer with St. Marylebone Borough Council, who died on August 26th last, left £6,834 gross, with net personalty £6,577.

---

A fund has been created as a memorial to the late **Sir William Chamberlain**, chairman of the Traffic Commissioners, North-Western Area. Sir William, who died in 1944, had been with a number of electricity and transport undertakings including Leeds and Belfast where he was engineer and manager.

---

## Rural Electrification

THE Kirkcudbright County Council is the only local authority in the country operating a rural electrification scheme over a complete geographical county. Despite the low density of population—50 per sq mile—noteworthy success was achieved in the first six years of operation up to the outbreak of war and in 1938-39 a 30 per cent expansion in sales was recorded. The normal programme has since been considerably retarded, but plans have been prepared for the difficult task of extending the supply to the remaining sparsely inhabited parts of the area. The county engineer (Mr. A. N. Bott) states in his report for the year to May 15th last that although various wartime loads were lost consumption increased by 12 per cent to 10·8 million kWh. For all classes of supply the average price received (1·55d.) was 14 per cent lower than in 1939. Electric storage boilers are used at five of the larger dairy farms to provide steam and hot water, the average revenue per installation working out at roughly £50 per annum. Electrical grass drying plant is in operation on one farm.

It is hoped, by pursuing an active sales policy, to avoid tariff increases, but the report adds that the results of the current year's working may necessitate a further call upon the reserve fund. For 1945-46 there was a deficit of £3,057, reducing the reserve to £9,295, although revenue rose by £10,443 to £74,147. The net increase in consumers connected during the year was 318, including 33 farms.

# Views on the News

## Reflections on Current Topics

ALL the indications point to the gradaul return of natural rubber to supplant synthetic in the British electrical industry. One reason is that it is cheaper, but an even greater one is that in spite of its cheapness it is actually better. During the war the virtues of synthetic rubber (like those of the carrot and potato) were loudly acclaimed by officially-directed propaganda but now its advantages appear not to be so great. We left the United States to build up a synthetic rubber industry to supply our needs as well as their own and now they are saddled with a problem for which all solutions are expensive. American manufacturers, too, seem generally to prefer the natural product but, apart from the waste of capital, the future is too uncertain to permit the abandonment of the industry or its too-drastic curtailment.

* * *

With such strong competition it must be extremely difficult for designers of electric irons to think of new selling points. I was interested to notice therefore the special features of a new model just put on the American market. Emphasis is laid on the energy-saving characteristics of the apparatus. With a sole-plate 16 per cent larger and 28 per cent longer than the average of five other leading makes, a greater area is covered with each stroke, while the use of a side instead of a back rest is said to conserve the heat besides giving greater stability. With regard to weight too, I have always been under the impression that a certain amount was necessary to achieve the best results. The makers claim, however, that with correct balancing and accurately controlled heat 3¾ lb is quite sufficient.

* * *

A correspondent has unearthed and sent me a page from the *Japan Weekly Chronicle* of June 14th, 1917, in which a remunerative "racket" was described in a letter. The writer said that in Kobe and Osaka the electricity supply authorities had informed their customers that as the existing "key sockets" had been found defective they would have to pay one yen for new ones. The writer estimated that for half a million sockets one of the companies would net 200,000 yen, apart from the proceeds from the sale of the old sockets as scrap. It was pointed out that the companies themselves were responsible for installing the defective sockets in the first place making a profit on them at the time. My correspondent ironically suggests that this may be a useful tip for supply companies here. *Ex oriente lux !*

* * *

What appears to be a somewhat elaborate method of remotely indicating boiler readings is reported to have been undergoing tests at a New York power station. The system is stated to involve the use of a photo-electric camera which is focused on the gauge and by means of television the picture is transmitted to the control room. Four units are necessary—the camera with deflection unit, two small power units and the viewer, apart from a 300-W spotlight for illumination.

* * *

It was rather ingenious of Mr. C. T. Melling, the Luton "Chief," in proposing the health of the guests at last week's opening of the new Leighton Buzzard "Electricity Service Centre", to have discovered such an apt excerpt from Tennyson. Sir John M. Kennedy was the principal guest and Mr. Melling's quotations were from the second of "Early Sonnets" dedicated to "J.M.K." —"Spurr'd at heart with fieriest energy" and "Thou from a throne mounted in heaven wilt shoot into the dark Arrows of lightning."

* * *

At the same gathering the chairman of the Luton Electricity Committee boldly expressed the hope that Leighton Buzzard would use more and more electricity. He did this despite the presence at the luncheon of the Regional Officer of the Ministry of Fuel and Power—but no doubt he was taking a long-term view.

* * *

A correspondent asks whether, following the example of the National Coal Board, the proposed British Electricity Authority will have a special flag and whether employees will be required to salute it. It would certainly give the country a festive appearance if there were such a flag flying at the top of every grid tower, but as to making obeisance before it . . . —**REFLECTOR.**

# Turbine Clearances

## Suggested Improvement in High-Pressure Impulse Machines

By H. Barson, A.M.I.E.E.

IT is usual practice to have steam leakages from steam turbines restricted both by radial and axial clearances. On "end-tightened" turbines the latter are made finer than the radial clearances.

In service the clearances tend to increase, with resulting increased steam leakage past blade tips and through glands. Examination after opening up a turbine nearly always shows that the axial clearances (F and G in Fig. 1) have at some time closed up, the blade shrouding having rubbed on the nozzle rims, and the rotating gland labyrinths having rubbed on the axial projections of the stationary labyrinths. Further, F and G having been originally set equal (say about 0·010 in. each) are found after opening up to have worn practically equally (say to about 0·035 in. each).

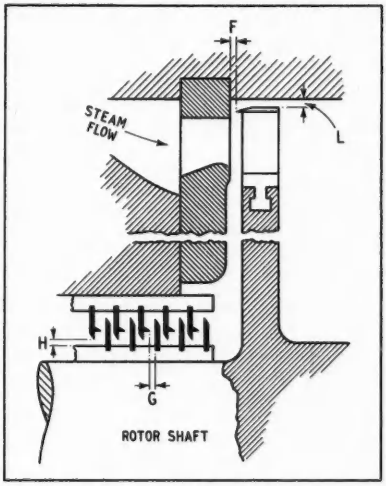



**Fig. 1.—Turbine nozzle, first blade wheel and gland**
Radial clearances: L for blades; H for glands.
Axial clearances: F for blade shrouding; G for glands.

The behaviour of three identical 30-MW turbo-alternators, all showing very similar characteristics in service and similar characteristics of wear on opening up, led to an attempt to find an explanation. Following an overhaul, during which clearances F and G had been set as nearly as possible to their original figures, the set was loaded up gradually to 20 MW and all controls were set so as to maintain this load for a considerable time.

A quarter of an hour later sealing steam no longer escaped from the vent pipe of the inlet gland of the high-pressure cylinder and sealing had to be re-established by partly closing the gland leak-off regulating valve. During the following 26 hours or so (load still 20 MW) it was found necessary to keep opening the gland leak-off regulating valve. When the turbine

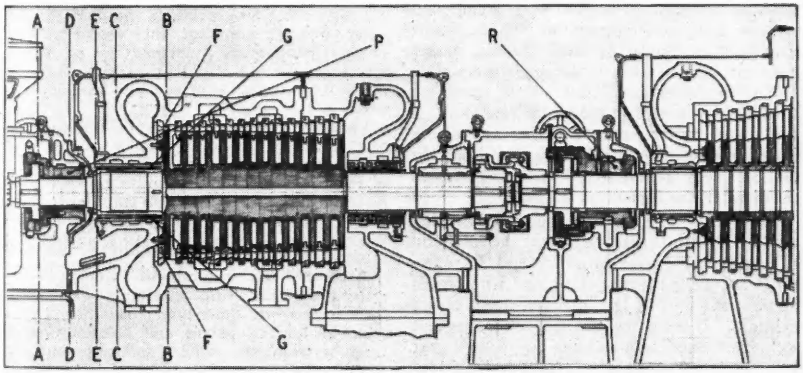



**Fig. 2.—Section of high-pressure and intermediate-pressure cylinders**

had reached a settled state, this valve was slightly more open than it had been at the commencement of the steady run at 20 MW. During this period the inlet gland of the intermediate-pressure cylinder had shown a very similar performance to the one on the high-pressure cylinder.

The very fact of the rubbing of the blade shroudings and gland labyrinths indicates that its most probable cause was the different rates of expansion of cylinders and rotor shafts. The behaviour of the gland-sealing steam showed that the gland clearances had decreased and gave some idea when this took place, that is not during the running up of the set, but after it had been running for two hours and on load for 1¼ hours.

It would appear from Fig. 2 that this closing of clearances is just what might be expected. The rotor is located in its cylinder by the thrust bearing at AA. The important part of the difference of expansion of cylinder and rotor takes place between AA and BB. The part of the cylinder which expands first and most is the steam belt between BB and CC, because all steam to the turbine (except gland-sealing steam) passes first through the steam belt, and the rate of expansion from cold depends mostly on the rate of steam flow through the steam belt. In addition to the expansion between BB and CC the cylinder expansion between CC and DD will be considerable due to conduction through the main casting from the steam belt.

### Rotor-shaft Heating

The steam which heats the rotor shaft between BB and EE (apart from a small amount of gland-sealing steam during the running-up period) is the very small and almost dormant proportion which, after expansion through the first nozzles, passes between the first rotor wheel and nozzle plate to the high-pressure gland. It is when the turbine is on load that the steam flow through the steam belt is most effective in causing expansion, so it is hardly surprising that the trouble with differential expansion should occur after the turbine is on load.

In Fig. 2, P represents the main bearing combined with thrust bearing at the inlet end of the high-pressure cylinder, and R represents the main bearing combined with thrust at the inlet end of the intermediate-pressure cylinder. If these two bearing units P and R were each fitted with an axial adjustment gear sufficiently robust to stand regular adjustment in either axial direction at will under all conditions of turbine load, it would then be possible to maintain the axial clearances such as F and G at standard measurements under all conditions of turbine operation.

Some form of indicator would be necessary for use in conjunction with the proposed adjustment gear, and a calibrated gland leak-off valve for each of the two glands concerned should best answer this purpose, as it is not the axial position of the shaft which is required to be known but the clearances of the gland labyrinths and blade shrouds. In effect, the gland-steam leak-off discharge would be regulated by altering the positions of the main thrust bearings instead of regulating the gland leak-off valves.

The idea of having the bearing units P and R adjustable axially has already been used, but is usually provided for erection and maintenance purposes only and is neither intended for, nor capable of, use when the turbine is on load.

---

## Electrical Machine Design

### Teaching and Practice

THE way in which electrical machine design is taught in colleges and by textbooks does not completely line up with the principles followed in manufacturing establishments. An endeavour to indicate how such teaching might be modified and amplified so as to be of greater service to men entering industry is made by MR. L. H. A. CARR (Metropolitan-Vickers Electrical Co., Ltd., and Manchester College of Technology, part-time) in a paper submitted to the Institution of Electrical Engineers.

The causes of differences between teaching and practice are discussed and difficulties experienced by students on their first entry to a design office are analysed. Students need a fuller understanding of the nature of the physical phenomena concerned; in particular, armature reaction and leakage reactance, the physical backgrounds of which are discussed in detail by the author.

Fallacies in theory are exposed as well as corresponding mis-statements in many textbooks about iron loss and the leakage reactance of end-windings; more accurate information is given in the paper, which also contains particulars of unbalanced magnetic pull, stray loss and the crawling of induction motors, suitable for inclusion in a design course.

Recommended methods of calculation are stated, together with constants determined from experience, the paper concluding with a table of loading curves and temperature-rise formulæ, which should be of service to teachers, as well as a bibliography of 39 references to the subject.

# Overseas Electrical Trade

## Record Exports in 1946

WITH the publication of the Board of Trade returns of imports and exports for December it is possible to assess results for the first complete post-war year, and so far as the electrical industry is concerned the position may be regarded with some satisfaction.

Electrical exports in December did not reach the record level attained in the preceding month but nevertheless (and in spite of the Christmas holiday) they were above the previous monthly average for last year. The total value of £5,133,016 was nearly three times the average monthly figure for 1938 and about twice the December, 1945, total.

Once again radio apparatus was the leading item, its value being over six times the 1938 monthly average. The cable class as a whole advanced from about £360,000 to £802,000. Electrical machinery exports, although much greater than in 1938, showed a smaller proportionate advance, notably in the large generating sets, which was to be expected. For the rest the increase was general.

Distribution of exports during December followed the lines of the previous months of last year. It is disappointing to see that Australia's imports of goods and apparatus from this country were lower in value in December than in an average month of 1938. Other countries whose purchases were smaller than before the war were Russia, Poland, Italy and Roumania.

Electrical imports in December were higher

TABLE I.—PAST YEAR'S ELECTRICAL EXPORTS AND IMPORTS

| Class | Exports | | | Imports | | |
|---|---|---|---|---|---|---|
| | 1946 | 1945 | 1938 | 1946 | 1945 | 1938 |
| | £ | £ | £ | £ | £ | £ |
| Telegraph and telephone wires and cables, submarine | 758,918 | 342,430 | 207,473 | 25,320 | 1,119,164 | 374,948 |
| Ditto, not submarine | 2,665,462 | 1,044,109 | 861,638 | | | |
| Wires and cables, other than telephone and telegraph, rubber insulated | 2,905,040 | 1,509,318 | 1,410,403 | | | |
| Ditto, insulation other than rubber | 4,425,935 | 1,509,844 | 1,839,077 | | | |
| Radio apparatus | 7,400,354 | 1,809,209 | 1,795,119 | 4,415,511 | 12,271,961 | 901,906 |
| Telegraph and telephone apparatus, other than radio | 4,980,057 | 2,596,250 | 2,912,595 | 36,079 | 732,741 | 110,919 |
| Electric carbons, furnace | * | * | * | 64,091 | 7,956 | 48,649 |
| Other electric carbons | * | * | * | 70,578 | 129,259 | 27,612 |
| Electric lamps | 1,289,523 | 824,042 | 593,282 | 8,352 | 188,997 | 123,175 |
| Other lighting apparatus | 2,054,553 | 545,376 | 582,783 | 16,602 | 253,948 | 463,949 |
| Primary batteries | 562,827 | 169,121 | 162,862 | 9,853 | 267,295 | 42,592 |
| Accumulators, portable | 1,344,273 | 388,754 | 346,485 | * | * | * |
| Ditto, stationary | 174,759 | 40,189 | 237,272 | * | * | * |
| Ditto, parts and accessories | 559,229 | 209,909 | — | * | * | * |
| Electric cooking and heating apparatus | 1,271,090 | 247,541 | 367,964 | * | * | * |
| Commercial electrical instruments, including ammeters, voltmeters, etc., and parts | 652,938 | 347,758 | 190,536 | 83,649 | 232,003 | 384,688 |
| House service meters | 534,714 | 130,807 | 189,496 | | | |
| Other electrical instruments | 501,161 | 143,693 | 115,350 | | | |
| X-ray apparatus, vacuum tubes and parts | 688,599 | 168,930 | 58,573 | 163,027 | 316,478 | 116,810 |
| Insulating materials, not elsewhere specified | 1,238,872 | 336,003 | 232,122 | * | * | * |
| Unclassified electrical goods and apparatus | 3,383,198 | 1,438,194 | 1,327,375 | 136,111 | 3,215,980 | 511,557 |
| Generators, complete, up to 200 kW | 788,694 | 961,622 | 456,853 | * | * | * |
| Ditto, over 200 kW | 2,448,283 | 861,733 | 1,428,953 | * | * | * |
| Ditto, parts | 742,832 | — | — | * | * | * |
| Motors | 2,829,324 | 1,553,696 | 1,740,540 | 62,586 | 111,306 | 312,400 |
| Convertors and transformers | 2,157,428 | 1,243,621 | 1,215,654 | * | * | * |
| Rectifiers for power house use | 136,508 | 54,113 | 41,558 | * | * | * |
| Motor starting and controlling gear | 914,534 | 371,120 | 610,392 | * | * | * |
| Switchgear and switchboards, other than telegraph or telephone | 2,777,959 | 2,143,953 | 2,214,402 | * | * | * |
| Other electrical machinery | 218,850 | 5,156,306 | 185,960 | 46,928 | 2,494,815 | 173,459 |
| Electric vacuum cleaners and parts | 1,030,314 | 71,067 | 319,941 | 1,548 | 183 | 90,225 |
| Other electrically-operated portable appliances | 488,227 | 64,184 | 124,730 | 24,458 | 85,868 | 205,291 |
| Total | 51,924,455 | 26,282,892 | 21,769,388 | 5,164,693 | 21,427,954 | 3,888,180 |

* Not separately classified.

in value than in the corresponding month of 1945 but were still considerably below the 1938 level. They consisted largely of radio apparatus.

Figures for the whole of last year are reproduced in Table I. It will be seen

TABLE II.—DISTRIBUTION OF PAST YEAR'S EXPORTS OF ELECTRICAL GOODS AND APPARATUS

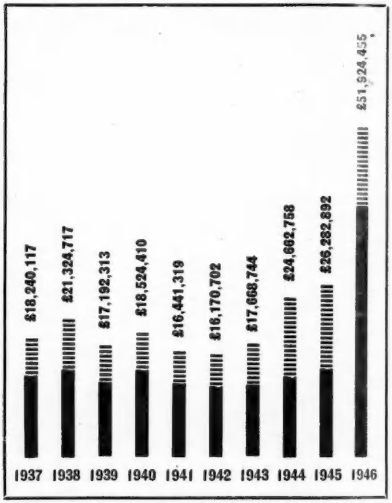
| Destination | 1946 | 1945 | 1938 |
|---|---|---|---|
| | £ | £ | £ |
| Eire .. .. | 1,194,832 | 420,311 | 450,746 |
| Channel Islands | 407,540 | 98,802 | 143,582 |
| Palestine .. .. | 927,093 | 122,385 | 100,452 |
| British West Africa | 447,005 | 252,117 | 154,374 |
| Union of South Africa .. | 4,734,285 | 1,866,383 | 1,891,223 |
| Southern Rhodesia | 331,056 | 108,496 | 114,890 |
| British East Africa | 411,300 | 185,107 | 93,959 |
| British India .. | 4,546,968 | 2,281,792 | 1,475,140 |
| British Malaya .. | 952,474 | 17,148 | 387,361 |
| Ceylon .. .. | 272,325 | 146,104 | 179,170 |
| Hong Kong .. | 398,504 | — | 154,485 |
| Australia .. | 2,409,720 | 2,388,705 | 2,361,872 |
| New Zealand .. | 1,643,409 | 1,054,077 | 1,150,218 |
| Canada .. .. | 252,615 | 452,169 | 149,783 |
| British West Indies | 313,339 | 160,446 | 154,644 |
| Other British Countries .. | 1,003,248 | 327,611 | 316,030 |
| Soviet Union .. | 687,912 | 1,463,217 | 441,364 |
| Finland .. .. | 273,464 | 6,699 | 69,884 |
| Sweden .. .. | 820,746 | 46,923 | 164,826 |
| Norway .. .. | 1,007,901 | 59,243 | 150,979 |
| Denmark .. | 865,664 | 44,789 | 219,386 |
| Poland .. .. | 198,869 | 28,470 | 115,513 |
| Netherlands .. | 975,575 | 59,486 | 242,276 |
| Belgium .. .. | 1,171,705 | 83,065 | 130,490 |
| France .. .. | 1,772,324 | 82,048 | 188,083 |
| French West and Equatorial Africa | 41,874 | 12,355 | 4,798 |
| Switzerland .. | 324,394 | 22,319 | 42,860 |
| Portugal .. | 978,780 | 172,844 | 77,980 |
| Portuguese East Africa .. | 64,754 | 18,602 | 83,092 |
| Spain .. .. | 676,736 | 145,951 | 45,697 |
| Italy .. .. | 23,603 | 14,187 | 67,910 |
| Czechoslovakia | 197,867 | 1,887 | 86,460 |
| Yugoslavia .. | 123,897 | 15,330 | 17,652 |
| Greece .. .. | 163,295 | 5,206 | 58,661 |
| Roumania .. | 986 | — | 160,195 |
| Turkey .. .. | 579,192 | 158,053 | 91,592 |
| Egypt .. .. | 1,030,462 | 393,329 | 154,464 |
| Iraq .. .. | 390,395 | 80,087 | 65,470 |
| Iran .. .. | 702,724 | 252,914 | 195,955 |
| China .. .. | 473,252 | 57,103 | 48,509 |
| United States of America .. | 111,842 | 150,248 | 66,552 |
| Chile .. .. | 98,837 | 8,894 | 79,621 |
| Brazil .. .. | 364,304 | 80,129 | 133,476 |
| Argentine Republic | 831,305 | 112,380 | 544,642 |
| Other Foreign Countries .. | 2,193,130 | 344,066 | 404,089 |
| Total .. | 37,391,502 | 13,801,477 | 13,430,405 |

that the total for electrical goods and machinery approached double the 1945 amount and was 140 per cent above the 1938 total. Goods and apparatus rose in greater proportion—180 per cent, for machinery made an advance of only 65 per cent.

About a fifth of the electrical exports were in the cable class which, as a whole, was responsible for £10,755,000 of the total (£4,319,000 in 1938). The total weight is given as 82,307 tons; there are no comparative figures for 1938. South Africa was the principal customer for cables, with British India second.

Radio apparatus exports constituted a seventh of the export total, British India taking the largest share (£1,038,488). Other important markets were South Africa (£517,561), Norway (£316,012), the Netherlands (£282,183) and Sweden (£216,436). The number of receiving sets and chassis (complete) exported rose from 84,639 in 1938 to 344,602 and the number of radio valves from 2,205,914 to 5,341,060.

An analysis of exports of telegraph and telephone apparatus shows that about a fifth (£965,970) went to Australia; other large




**Electrical exports by value during the past ten years**
(Black portion, goods and apparatus; rest machinery)

purchasers were South Africa (£768,000), British India (£260,933), Soviet Russia (£225,025) and New Zealand (£196,833).

Some indication of price advances is derivable from the fact that while the number of electric lamps exported rose from 19·7 million in 1938 to 35·2 million in 1946, the value increased from £503,000 to about £1,290,000. Similarly exports of house service meters were 165,000 valued at £189,000 in 1938 and 222,000 valued at £535,000 in 1946.

In 1946, as seen from Table II, South Africa (£4,734,285) was the leading buyer

of British electrical goods and apparatus, a position occupied by Australia before the war. Australia (£2,409,720) took third place in 1946, the second largest customer being British India (£4,546,968). New Zealand, in proportion to her population, made a good showing at £1,643,409. Among foreign countries the leading places were taken by France (£1,772,324) and Belgium (£1,171,705).

As regards electrical machinery exports volumes were only about the 1938 figures: the total 1946 tonnage is given as 44,262 as compared with 44,645 tons in 1938. It can be calculated (disregarding variations in character) that the value per ton rose from £177 in 1938 to £294 in 1946.

The value of electrical goods and apparatus imports during 1946 was considerably below the 1945 level and was only slightly above that for 1938. Something like four-fifths of the total (£4,113,347) came from Canada in the form of radio equipment. The only other substantial supplier was the United States (£593,021). Machinery imports were just over a quarter of those for 1938.

# PARLIAMENTARY NEWS

## By Our Special Reporter

LAST week in the House of Commons Mr. Walker-Smith and other members called attention to the unpunctual running and cancellation of the L.N.E.R. suburban trains, and urged extended electrification of the system as one remedy.

Mr. G. R. Strauss, Parliamentary Secretary to the Ministry of Transport, in reply, said that the only complete solution of the problem lay in the electrification of some, if not all, of the lines. When that happened they would get new locomotives, new rolling stock and many more trains. Electrification would have taken place some years before the war if the L.N.E.R. had been in a strong enough financial position to raise the capital. They were unable to do so, and those lines were not electrified. The present plans were these. There would be the electrification of the Loughton line, which was the central line, as far as Woodford this year. Then would come the electrification of the Shenfield line. The plan was to put this into operation as soon as possible, but it could not be completed before two years at the earliest. When that took place the number of trains able to operate on that line would be nearly doubled. Apart from that, the only other alteration could come from an increase in the number of engines which could be made available.

### Electricity Restriction Order

Sir J. Mellor moved to annul the Electricity and Gas (Reduction of Consumption) Order, dated December 10th, 1946. He explained that the Order purported to reduce the consumption of electricity and gas, but, owing to the form in which it was made, it would, he claimed, largely defeat its own object. It applied to industrial undertakings which consumed more than a specified amount of coal, electricity, or gas, apart from ironworks, steelworks, foundries, coke ovens, docks, harbours, canals and collieries. The Order provided that during the first three months of this year such concerns must restrict their rate of consumption of electricity or gas to an amount not exceeding the rate of consumption during a basic period. It was evident that the Order would penalise those undertakings which were most economical in the basic period and would be comparatively indulgent to those which were most wasteful.

Mr. Boyd-Carpenter, who seconded, deprecated this restrictive Order in the second winter of peace and described as "sloppy rationing" the fact that unscrupulous people should be permitted to wreck the whole system, and Sir Peter Bennett declared that it was not helpful to people who had made sacrifices to find that those who had not were very much better off as a result of their negligence.

Mr. Gaitskell, Parliamentary Secretary to the Ministry of Fuel and Power, said that the Order was made because the Government felt, in view of the serious fuel situation, that it was no longer possible to go on leaving the consumption of electricity completely uncontrolled. It was the increased consumption of electricity, and, to a smaller extent, gas, which was largely responsible for the present difficult situation. They could not be satisfied with voluntary restriction. It would no doubt be very nice to fix for each industrial consumer just the right amount of electricity which it would be fair to allow him to consume, but how could they possibly do that? There were at least 30,000 firms involved.

The motion to annul the Order was negatived by 263 votes to 79.

### What is "Extravagance"?

Colonel J. Hutchison asked the Minister of Fuel and Power what definition he proposed to give as to what was considered an extravagant consumption of electricity in connection with the Control of Fuel Order (No. 3), 1942.

Mr. Shinwell said that the Order prohibited the waste or uneconomical use of fuel, including electricity. It must be clear that circumstances

differed so widely in individual cases that no general definition was practicable. In any case, interpretation of the law was a matter for the Courts.

### Coal Stocks

Replying to Mr. Granville Sharp Mr. Shinwell said that the latest figure of stocks held by the electricity supply industry was 1,293,156 tons as compared with 2,315,911 tons held a year ago. In view of many variable factors, he could not forecast stocks for early March but power station requirements had the highest priority and everything possible would be done to maintain stocks at an adequate level.

### Quality of Coal

Sir Arnold Gridley asked the Minister of Fuel and Power what steps had been taken during the last eighteen months to provide for the power stations the coal of similar quality to that with which they were supplied before the war, and how soon the resumption of such deliveries could be relied on.

Mr. Shinwell said that all possible steps had been taken to enable the coal mines to provide suitable qualities of coal to power stations, but the quantity required was greatly in excess of what it was before the war, and was still increasing. It must be some time before the quality could be restored to pre-war standards.

Sir Arnold Gridley asked if the Minister was aware that if the mines were in a position to supply the class of coal for which the power stations and boiler houses were designed, the existing plants would be able to supply another 400,000 H.P. at the peak of the load, and thus diminish the amount of "shedding" which had to be done. Mr. Shinwell replied that there was some substance in that, but the coal owners had been unable to provide the necessary facilities for screening and washing.

### Supply to Hospitals

Replying to a question by Mr. Collins, Mr. Shinwell said that electricity undertakings were instructed to avoid as far as possible cutting of supplies without telephone warning to hospitals. Though it was not possible to guarantee that in no circumstances would supplies to hospitals ever be interrupted, he had not heard of any cases where the electricity undertakers had not been able to make satisfactory arrangements with the hospitals in their areas.

### Idle Plant

Mr. Collins asked if the Minister would look into the question of using idle generators. Was he aware that at Taunton there were two idle generators and that notice was sent to the Central Electricity Board on November 11th, and yet no action was taken, although the use of these generators would have avoided load shedding in the area?

Mr. Shinwell said he was surprised to learn that there were any idle generators that could be made available for immediate use; if Mr. Collins would send him particulars he would have them examined.

### Lighting Economy

Mr. Shinwell told Capt. Crowder that street lighting was at present being carried out with an overall saving of 50 per cent or more on pre-war fuel consumption by the voluntary co-operation of lighting authorities. He was considering whether any further economies were practicable.

Answering Mr. Gibson, Mr. Shinwell said he fully appreciated the difficulties of tradespeople but regretted that he was unable at present to consider any relaxation of the restrictions imposed upon shop lighting by the Control of Fuel (No. 3) Order, 1942.

### Allocation of Poles

The President of the Board of Trade (Sir Stafford Cripps) informed Colonel Crosthwaite-Eyre that allocations of telegraph and transmission poles had been made for the first quarter of 1947 as follows:—Post Office, nil; Electricity Commission, 46,900; other Departments, 12,400; a total of 59,300.

### Television

During a debate on television Mr. J. Lewis said that technicians in television services at Alexandra Palace had to use out-of-date equipment in inadequate accommodation. He maintained that there was opposition on the part of large vested interests running the entertainment in this country. The Government and the B.B.C. had failed to give the necessary finance to this great development. The Government should give it a State grant and make it an independent organization.

Mr. Cobb said that it was important from the export point of view that British television should be kept ahead of all other countries.

Mr. Burke, Assistant Postmaster-General, said that Alexandra Palace was not adequate and the Corporation would like to improve upon it. The difficulty was it could not without building.

Referring to future development Mr. Burke said that the Government was anxious that a nation-wide service should be put into operation at the earliest possible moment. It was proposed that the service should be carried to Birmingham on the way to the heavily populated areas of the north. Inquiries had been made for a suitable site in Birmingham. It was proposed to run a two-way link between London and Birmingham so that programmes could be sent in either direction and by either cable or radio link. It would not be necessary for people to confine themselves to 405-line definition. It was hoped there would be a 1,000-line transmission and that colour definition would be possible as well.

# Luton Enterprise

## Recent "Landmarks"

UNDER the guidance of the borough electrical engineer (Mr. C. T. Melling) the Luton Corporation undertaking continues to expand and improve in spite of present-day handicaps. The Corporation's 215 sq mile area of supply embraces besides the borough the urban districts of Dunstable, Leighton Buzzard and Linslade and showrooms (or "Electricity Service Centres") exist in Luton, Dunstable and Leighton Buzzard. Those in the last-named town became inadequate to meet the growing interest of the population, and consequently new premises have been leased and converted and were opened last Friday by Sir John Kennedy, O.B.E., deputy-chairman of the Electricity Commission.

Before the opening ceremony there was a luncheon at the Swan Hotel, Leighton Buzzard at which Councillor C. A. Sinfield, chairman of the Luton Electricity Committee, presided.

Introducing Sir John Kennedy, Councillor Sinfield said that they had recently reduced the price of electricity in Leighton Buzzard to the same level as in Luton and as a result they expected a material increase in consumption in the town. He emphasized the fact that service to consumers was his Department's aim and referred to the undertaking's work in the rural area. The Luton Council had just approved a £300,000 programme of development.

Sir John Kennedy, in proposing the toast "Electrical Development in Leighton Buzzard and Linslade," commended the activities of the Luton electricity undertaking and made particular reference to rural electrification. This could be economical only if balanced with the urban load, which did not mean that town dwellers would have to subsidize the rural population's electricity. The greater use of electricity by urban consumers would enable its price to be reduced to a level which rural inhabitants could afford. Sir John expressed approval of the setting-up of an area advisory committee in which the various districts in the supply area were represented and he considered it very wise to have at least one woman on the Electricity Committee.

Councillor W. J. Baker, vice-chairman of the Leighton Buzzard U.D.C., in the course of his reply to the toast expressed his appreciation of the Luton Corporation's service and of the new sodium-vapour street lighting system in the High Street which made Leighton Buzzard one of the best-lighted towns in the country.

The health of the guests was proposed in felicitous terms by Mr. C. T. Melling who spoke very appreciatively of the work of his staff in the operation and extension of the Department's services. He assured local contractors that the Department wished to co-operate, not compete with them. The response to the toast was made by Councillor W. E. Durrell, chairman of the Linslade U.D.C.

**Leighton Buzzard "Electricity Service Centre"**

The new Electricity Service Centre has been constructed in a building which was a coaching inn two hundred years ago and the work involved the removal of the whole of the ground floor and erection of steelwork, under the supervision of Mr. R. Connor, A.M.I.E.E., the Department's technical and constructional engineer. The undertaking's Construction Department was responsible for the work, and the main contractors were Messrs. A. W. Oakley. Bronze and natural Portland stone have been used for the exterior. The showroom is 70 ft long by 20 ft wide and has a polished oak floor. At one end is a demonstration room seating 42 with a raised platform behind which is a model kitchen. The lighting is by Siemens fluorescent tubes. The basement of the building is used as a stores.

An excellent display of appliances of the most modern design has been arranged, but in view of the shortage of many of these waiting lists have had to be opened for would-be purchasers. Attractive hire and hire-purchase systems are in operation.

In the lighting of the High Street, B.T.H. sodium lamps have been employed; there are 14 of 140 W, 30 of 85 W and 220 of 45 W.

# CORRESPONDENCE

*Letters must bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.*

## N.A.L.G.O. and Electricity

FOR the benefit of "Mains Engineer" (*Electrical Review*, January 17th) and others like him, I wish to point out that, at any rate, the Electrical Power Engineers' Association has the matter of his complaint in hand. The following extract from the E.P.E.A.-N.A.L.G.O. Agreed Statement, published in the *Electrical Power Engineer* for December, 1946 (page 818) should be of interest:

"(*a*) Professional and technical staffs who are not eligible to join the E.P.E.A., i.e., those who are not covered by the Agreement of the National Joint Board, are free to join N.A.L.G.O. unconditionally.

"(*b*) That a member of the technical engineering staff of an authorized undertaker such as in the electricity supply industry shall not be admitted to membership of the N.A.L.G.O. unless he is a member of the E.P.E.A."

*Merton Park, S.W.*20. E. PATON.

WITH reference to "Mains Engineer's" letter in your issue of January 17th, I should like to assure him that the state of affairs which he fears does not in fact exist as, under an agreement made between the Electrical Power Engineers' Association and the National Association of Local Government Officers in 1928, the latter recognizes the Schedule of the National Joint Board for the Electricity Supply Industry as applicable to the technical staffs in electricity undertakings and leaves entirely to the E.P.E.A. any negotiations with regard to their salaries and conditions of service.

Many members of the staffs of electricity undertakings have joined N.A.L.G.O. within recent months, but this does not imply any modification of the above agreement. It results largely from recognition, by those members who are not covered by the N.J.B. Agreement, of the facts that present events make necessary the institution of similar negotiating machinery which will cater for them and that N.A.L.G.O. is prepared to represent them in the matter.

The Northmet Branch of N.A.L.G.O. was the first non-municipal public utility branch to be formed within the Association. There are now more than 1,000 members, including approximately 97, 94 and 32 per cent of the permanent clerical, sales and technical staffs respectively. It may therefore interest "Mains Engineer" to know how the matter to which he refers was covered when the branch was formed and I cannot do better than to quote in this connection. The first of the objects stated in the Rules and Constitution is:—

"To organize within the Branch of the Association all the professional, technical, administrative sales and clerical staffs of the Northmet Power Co., and to engage in bona fide trade union activities on their behalf; provided that the functions of the branch shall not extend to matters affecting the salaries and service conditions of the technical staffs coming within the purview of the National Joint Board for the Electricity Supply Industry except by mutual agreement between the Association and the organization(s) concerned."

*Hadley Wood, Herts.* J. G. PARK, M.I E.E. (Vice-chairman, Northmet Branch, N.A.L.G.O.)

## Street Lighting Suggestion

I HAVE travelled regularly over two of London's "arteries"—the Great West Road and the Chertsey By-pass—narrowly missing pedestrians who for some reason choose the worst parts of the road for crossing. They appear to emerge from a pool of darkness to which there is no background to silhouette them. This causes me to wonder whether we are going about street lighting in the right way and whether the secret of good safety lighting is not to illuminate the pavement with a cut-off on the kerb line. This would have the effect of producing a background against which obstructions would be clearly seen. I wonder if this has been tried and what the objections are.

I consider that short standards, closely spaced, would harmonize with most forms of architecture, particularly that of residential areas consisting of two-storey villas. It would also eliminate the nuisance caused by light from high standards shining into bedroom windows. There are other advantages, among them being that there are no catenary wires or overhanging brackets.

*London, S.W.* 15. BACKGROUND.

# COMMERCE and INDUSTRY

## Control of Civil Building. Spanish Radio Equipment Contract.

THE Minister of Works has decided to retain for a further six months the present limits of cost above which licences are necessary for building and civil engineering work, and to discontinue the exception in respect of work carried out on private dwellings with unpaid labour; to simplify the administration of the licensing system by delegating to local authorities as his agents the additional power of issuing licences for *all* housing work, irrespective of cost; and to enable local authorities in England and Wales to prosecute for contraventions of the licensing regulations.

A new Order, the Control of Building Operations (No. 8) Order, 1947 (S.R. & O. 1947 No. 74), provides that, between February 1st and July 31st, work may be done on any single property without licence, if its cost, together with the cost of any other work done without licence on that property during the six months, does not exceed £10. In addition, work costing a total of not more than £2 may be carried out without licence in any one month. This £2 monthly allowance is non-cumulative. Electrical installation work is covered by these arrangements.

### Purchase Tax

Notice No. 78 (Goods Chargeable with Purchase Tax), issued by the Commissioners of Customs and Excise (City Gate House, Finsbury Square, E.C.2), has been revised and copies of the new edition are being sent by local Collectors of Customs and Excise to all registered traders. This revised edition, dated December, 1946, supersedes Notices Nos. 78 (July, 1944) and Supplement (June, 1946), 78D (October, 1945), 78E (April, 1946) and 78F (July, 1946) and all additions and amendments thereto issued by the Commissioners up to December 1st, 1946.

### Iron and Steel Control

The Minister of Supply has made the Control of Iron and Steel (No. 56) Order which came into force on January 21st. The Order amends certain maximum prices, the principal alterations being increases in the price of steel castings, chain link fencing and mattress wire. Copies of the Order (S.R. & O. No. 78 1947) may be obtained from H.M. Stationery Office, price 1d.

### Sheffield University Extensions

A ten-year plan of extensions involving an estimated expenditure of £6,000,000 and which aims at eventually providing for four times as many students as in pre-war years, is proposed by the Sheffield University. The proposals include a new foundry and other extensions to the Department of Metallurgy and an enlargement of the Department of Engineering. It was announced at a recent public meeting held in the Memorial Hall that the University Development Campaign, which aims eventually at raising the £6,000,000, has already received donations amounting to £52,849. This amount included amongst others a sum of £5,000 given by Thos. W. Ward, Ltd.

### E.D.A. at I.M.E.A. Convention

As in previous years, the British Electrical Development Association has been asked to arrange an exhibition in connection with the forthcoming annual convention of the Incorporated Municipal Electrical Association (Bournemouth, June 23rd to 27th). Manufacturers who wish to take part in the exhibition are asked to communicate with the general manager and secretary of E.D.A. (Mr. V. W. Dale), 2, Savoy Hill, London, W.C.2. At a later date a meeting of prospective exhibitors will be held to deal with the allocation of space and other matters.

### Diesel-Electric Sets for Guernsey

The States of Guernsey Electricity Department has placed an order jointly with Associated British Oil Engines, Ltd., and the Brush Electrical Engineering Co., Ltd., for two Petter-Brush Diesel-electric sets and transformers for the power station at St. Samsons. Each set comprises a Petter superscavenge 6-cylinder engine developing 576 B.H.P. at 600 r.p.m. and driving a Brush alternator with an output of 400 kW, 400 V, 50 cycles, 3-phase, which in turn is connected to a 500-kVA 400/6,600-V Brush transformer.

### L.M.S. Telephone Cable Contract

The L.M.S. Railway announces that a contract has been placed with Pirelli-General Cable Works, Ltd., for the provision and installation of thirty-eight-pair carrier and voice frequency loaded telephone cables between Euston and Watford, extending to the North End of Watford Tunnel (approximately nineteen miles from Euston).

### Transmitters for Spain

The first big order after the British Government's announcement of a Spanish trade drive is reported by Marconi's Wireless Telegraph Co., Ltd., whose associated company Marconi Espanola has succeeded in obtaining, in the face of strong foreign competition, a contract valued at 12,000,000 pesetas (approximately £270,000) for the supply of four short-wave broadcasting transmitters to the Spanish State Broadcasting Service. The transmitters, each

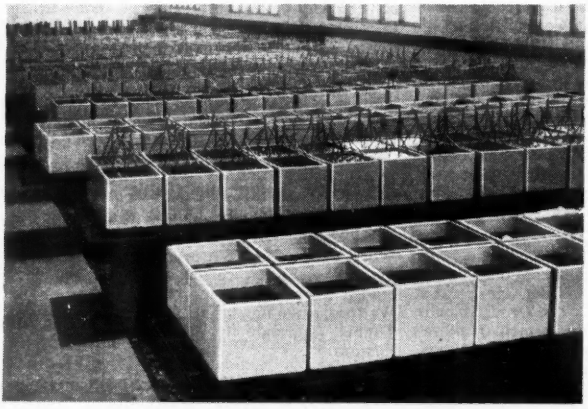
rated at 100 kW, are to be the Marconi Type TBS.802. Their manufacture, assembly, testing and installation, will be carried out by the Madrid and Chelmsford factories working in close collaboration.

## Surplus Stores Sale

The Ministry of Supply's first important sale of engineers' tools and equipment (mainly unused) is to be held at the Town Hall, Henley-on-Thames, at 11 a.m., on February 18th and 19th. Information and catalogues (6d. each) are obtainable from Henry Butcher & Co., 73, Chancery Lane, W.C.2 (telephone: Holborn 8411). The stores for disposal include lathe and planer tools, milling cutters and end mills, industrial diamond tools, segmental saws, miscellaneous drills, Coventry die head spare parts, "Do-all" British file saw bands, "Namco" chasers, die heads and dies, tool bits, stay bolt taps, reamers and cemented carbide and stellite tipped tools. The stores can be viewed at Marsh Lock Factory, Wargrave Road, Henley-on-Thames, from February 11th to 14th and February 17th.

## New Accumulator Factories

Although established only as recently as 1937, the Ensure Battery Co., Ltd., claims to be now one of the largest manufacturers of 2-V radio accumulators, besides making a considerable number of car starter batteries. Recently to cope with the rising demand for its products the company has moved from Bingley, to a new building at Cross Hills, near Keighley, and has also opened a 12,000-sq ft branch factory at Gargrave, near Skipton, solely for car battery production.



**Formation room at the company's new Cross Hills factory**

Both the new factories have been modernized to meet their new requirements and at the Cross Hills establishment, which is three times the size of the Bingley works, new offices and a formation room have been added. Mr. B. Birtwhistle, the managing director of the company, tells us, that as in most other factories, production is at present severely hampered by shortage of materials, and although between 6,000 and 7,000 batteries of all types are now made weekly (about 90 per cent of them being of one or other of the five types made for radio purposes), the lay-out of the works would allowout put to be trebled or quadrupled with ease. Manufacture of h.t. accumulators has had to be discontinued owing to the difficulty of obtaining glass containers but replacement plates are still made.

In transferring to the new premises the opportunity has been taken to modernize still further plant and methods. A new type of grid casting machine designed by the company's own engineers greatly accelerates production and improves the quality of the grids.

## A.S.E.E. Functions

The Association of Supervising Electrical Engineers is holding its annual dinner at the Connaught Rooms, London, W.C.2, on May 2nd. The Association's annual conference is to be held at the Victoria Station Hotel, Nottingham, on May 24th.

## Copper and Zinc Purchases

As a result of discussions with trade representatives the licensing restrictions for copper and zinc set out by the Ministry of Supply in December last, have now been modified.

It will still be necessary for firms applying for licences for copper to certify that the metal is needed to cover orders and that full allowance has been made for scrap intake. The total tonnage of unwrought copper, which any firm is permitted to hold (including stocks and forward purchases), has been increased to seven(instead of six) months' consumption at the average monthly rate of consumption in September and October, 1946. Firms whose current consumption exceeds by 10 per cent or more their consumption in this period may apply to be assessed on the higher basis.

In order that firms whose total holdings of copper exceed seven months' consumption may continue to book orders, the reduction of their position to seven months may now be effected more gradually; from February 1st they may apply for licences to acquire for any calendar month a tonnage equivalent to 90 per

cent of their monthly consumption in the basic period. In future all applications to the Directorate of Non-Ferrous Metals, 20, Albert Street, Rugby, for licences to acquire copper must be accompanied by a purchase order. Contracts will then be issued as heretofore. This means that where the copper is supplied by the Directorate, licences will no longer have any period of validity. Where the Directorate is not to be the supplier the licences will have a validity of seven days.

The same provisions as for copper apply to the licensing procedure for zinc with the exception that the total holding of unwrought zinc must not exceed six months' consumption at the basic monthly rate.

## Allocations of Tin Metal

The Ministry of Supply has announced more details of the allocations of tin metal made by the Combined Tin Committee in Washington. At a recent meeting in Washington the Committee recommended that only interim allocations for the first half of 1947 should be made at present amounting to approximately 50 per cent of the allocations recommended for the last half of 1946. These interim allocations (which do not include domestic production) are not to be regarded as constituting a pattern for final allocations; at a later date substantial additional quantities of tin will be available.

## "Atomic Age" Exhibition

On Thursday last an Atomic Age Exhibition organized by the *Daily Express* was opened at Dorland Hall, Lower Regent Street, S.W. 1. The exhibition is intended to explain to the public in the simplest possible terms the full meaning of atomic energy as a weapon and as a constructive force. There are three main sections. The first covers the science behind the bomb, illustrating the structure of the atom and leading up to details of the bomb itself. The second section describes the effects of the five atomic bombs which have so far been detonated, and the third section explains the immediate and future possibilities of atomic energy as a source of power. Models on show include the Cavendish Laboratory, the Battersea power station of the London Power Co., and an E.D.A. kitchen unit.

## Electric Vehicle Production

An exhibition showing Brush battery electric vehicles was held recently at the Great West Road Depot, Brentford, of Henlys, Ltd. The exhibition was opened by Mr. H. G. Henly in the presence of all directors of the company and directors and managers of the leading bakeries, dairies and electricity undertakings as well as directors of the Brush Electrical Engineering Co., Ltd. A complete range of vehicles was shown together with dis-assembled components and working models. Invitations were sent out to every baker, dairyman, corporation-owned electricity undertaking, private electricity company and all laundries throughout London and the Home Counties, for which the Henly organization is the sole distributor for all "Brush-Bred" vehicles. The Brush Company is now able to offer all buyers a delivery of one to eight weeks for any vehicles within the standard range.

## G.P.O. Training Schools

Schemes for the training of staff in all departments have been instituted by the General Post Office and an experienced training officer has been appointed for each Region. The Engineering Department has vocational training schools in each Region. There are sixteen in the Provinces with accommodation for about 1,000 students, and four in London providing instruction for 270 trainees. The Post Office is also setting up a Central Engineering School at Swynerton, Stone, near Stratford, which will have accommodation for 1,000 students and the necessary staff.

## Industrial Organization

The text was published this week of the Industrial Organization Bill which provides for the setting up of a Development Council in any industry for the purpose of increasing efficiency and productivity and to secure the best and most economical service to the public. Such a Council will have many functions, among them being the promotion of scientific research, inquiries into the best use of labour and materials, improvement of design, the certification of products, the training of personnel, market research, promotion of arrangements for co-operative organizations for supplying materials and equipment, co-ordinating production and marketing, etc.

One section of the Bill enables a Minister to collect a levy from any industry in which a Development Council does not exist for the purpose of research, export development or improvement of design; and the President of the Board of Trade is empowered to make grants to the Council of Industrial Design and design centres.

## E.D.A. Sales Lecture

The third of the series of sales lecture-meetings organized by E.D.A. (S.E. and E. England Area) was held recently in London at the E.L.M.A. Lighting Service Bureau, the subject being "Commercial Electric Cooking Development," and the lecturer Mr. L. H. Carmalt (B.E.A.M.A.).

Aspects dealt with were progress during the war, improvements and trends in design, materials and finishes, practical points in gaining the load, the price of equipment and the economics of large scale cookery. Mr. Carmalt advocated regular monthly inspection visits and a detailed examination and careful adjustment of all vital parts of equipment every

six months, and emphasized the low maintenance cost of electrical equipment when proper service was given. The many advantages of electricity were so great that it was not necessary to try to sell on running costs alone, and great saving was possible by the infrequency of redecorating necessary when electricity was used.

In hotels and restaurants, the consumption per kW connected was given as 400 to 1,200 kWh per annum, and consumption per kW of maximum demand 1,200 to 4,000 kWh. The maximum demand occurred two and a half hours before a main meal. If undertakings developed other loads at the same time, the commercial cooking peak would not be at all embarrassing. With regard to water heating, it was desirable to provide a 75 gallon water heater for a 100-meals kitchen, 150 gallons for a 500-meals kitchen and 250 gallons for 1,500 meals. A discussion followed the lecture.

## British Association Meeting

It is announced that the British Association for the Advancement of Science is to hold its annual meeting in Dundee from August 27th to September 3rd.

## Workers Sacrifice Warmth for Production

Eight hundred men and women employed at the Walton-on-Thames factory of the Hackbridge Electric Construction Co., Ltd. and the Hewittic Electric Co., Ltd., have agreed to work without heating so that the coal thus saved can be used for process purposes.

## Wild-Barfield Furnaces

In collaboration with E. S. Mowat & Sons, who have been the agents in South Africa of Wild-Barfield Electric Furnaces, Ltd., for many years, Wild-Barfield Electric Furnaces, Ltd., has formed a company registered in the Union, bearing the name Wild-Barfield (South Africa (Pty.), Ltd., with registered offices at 51, Milne Street, Durban, Natal.

## Calendars

A useful wall calendar with daily tear-off slips has been received from the Thames Wire & Cable Co., Ltd.

The picture selected by G. E. Wallis & Sons, Ltd., for their tasteful calendar, shows a young man removing tit-bits from an iced-cake and is called " Sampling ! "

## Trade Publications

**Lancashire Dynamo & Crypto, Ltd.,** Trafford Park, Manchester, 17.—Illustrated brochure (ML 52) briefly outlining the organization and products of the company and its associated manufacturing concerns.

**Wingrove & Rogers, Ltd.,** Polar Works, Old Swan, Liverpool.—Illustrated folder on the " Leader " battery propelled jack truck, pedestrian controlled, for factory and platform uses.

**L. G. Hawkins & Co., Ltd.,** 30, Drury Lane, London, W.C.2.—Folder illustrating the " Electric Hostess " electrically heated trolley for serving food in dining rooms.

**Quasi-Arc Co., Ltd.,** Bilston, Staffs.—Leaflet (TC.687) on a push-button regulator for controlling welders from a distance.

## Changes of Address

The address of the London Regional Office of the Ministry of Works is now 8, Cornwall Terrace, Regent's Park, N.W.1 (telephone: Museum 5030; telegraphic address: Travauxreg, Norwest, London). The address of the Regional Licensing Officer and the Regional Production Officers is 17, Cornwall Terrace, Regent's Park, N.W.1) (telephone: Museum 5030).

The Aluminium Development Association has removed to 33, Grosvenor Street, London, W.1 (telephone: Mayfair 7501).

## Trade Announcements

Suplex Lamps, Ltd., has removed to Suplex House, 239, High Holborn, London, W.C.1 (telephone: Holborn 0225).

The Bishop Sound & Electrical Co., Ltd., informs us that its address is now 108, Beverley Way, Kingston By-pass, S.W.20 (telephone: Malden 2849).

# Trade Marks

THE following applications have been made for the registration of trade marks. Objections may be made within a month from January 22nd:—

XCEL (design). No. 643,082, Class 9. Electric kettles, electric cooking utensils included in Class 9, domestic flat irons and soldering irons, and parts of, and fittings for, all such goods, none being included in other classes.—Elexcel, Ltd., Victor Works, Broad Green, Liverpool.

FROLIC. No. 642,706/7723S, Class 9 (application made to the Cutlers' Company, Sheffield). Electric flat irons.—Tool & Steel Products, Ltd., Abbeydale Works, Woodseats Road, Sheffield, 8.

TESVAC. No. 644,844, Class 9. High-frequency Tesla-coil testing apparatus.—Ferranti, Ltd., Wickentree Lane, Hollinwood, Lancs.

IHH (design). No. B644,067, Class 11. Installations for refrigerating and drying and parts (not included in other classes) of such goods.—International Harvester Co., 180, North Michigan Avenue, Chicago, Illinois, U.S.A. Address for service: c/o Urquhart-Dykes & Lord, Maxwell House, 11, Arundel Street, London, W.C.2.

HOUSEMASTER. No. 644,590, Class 11. Installations for lighting, heating, steam generating, cooking, refrigerating, drying, ventilating, etc.—C. J. Fox & Sons, Ltd., 117, Victoria Street, London, S.W.1.

# Soil Heating

## Results of a Horticultural Questionnaire

NINE months ago S. B. Jackson, Ltd., Windsor House, Victoria Street, London, S.W.1, commenced to market a soil heating outfit. Since then nearly 1,000 have been sold, each consisting of a waterproof 250-W step-down transformer furnishing a low-voltage output to 20 yards of buried cable, with provision for obtaining full, half or one-quarter heat. A questionnaire circulated to private customers produced a 92 per cent response.

Some 56 per cent of the installations were in greenhouses, 28 per cent in frames, 12 per cent under cloches and 4 per cent in the open. The principal crop was tomatoes, though others included cucumbers, melons, mushrooms, alpines and in one case orchids. The cable was laid out in various ways differing from that recommended. There was only one report of cable failure. The user had two cables (one spare) which only lasted four hours each due to lying in acidic ash material. In no case did the transformer fail, neither was there any public electric supply failure. As to the methods of employment, 67 per cent preferred to use the equipment continuously and change the heat as required. The remainder used the equipment intermittently, also with heat changing. A variety of reasons for changing the degree of heat was given, but the advantage of this facility was favourably reported upon.

### Load Analysis

Analysis of the period of usage and hours of use shows that the load is of very high diversity factor, 70 per cent of the energy being taken during the night. In the period under review all energy was used between March and September, except the "control" tests referred to later. The average electricity cost was of the order of 0·98d. per kWh and for commercial growers the average was 0·89d. per kWh.

In both yield and quality, 86 per cent reported improvement. The remainder stated that 1946 weather was against proper trial. In all cases of improvement the opinion expressed was that it could not have been obtained without electric soil heating Possibilities of bringing to maturity were improved, the appearance of crops was better and there was evidence that disease was less with even moderate soil heating.

In August, over the whole of the British Isles (the reports range from Inverness to the Channel Isles), the temperature during the night several times fell below 32 deg F. In all cases it was claimed that soil heating saved the crop. Several users in the open stated that it prevented soil waterlogging during wet weather. The three-heat feature was generally stated to be a necessity. It thus seems that the equipment justified its installation, but growers do not seem to appreciate that electricity can be cheaper than solid fuel on an overall thermal basis.

In the recent cold spell in December specially selected growers made some "contact" tests in frames and cloches growing lettuce. The frames gave 94 per cent success and the cloches 72 per cent with electricity on continuously, and it would appear that exceptionally low temperatures or the location of the equipment were responsible for the failures.

# H.V. Cable Demonstration

THE Lord Mayor of Birmingham (Alderman A. F. Bradbeer) on January 20th opened a high-voltage cable demonstration and exhibition of transmission equipment arranged by B.I. Callender's at Kingfairs Hall, Birmingham. The demonstration, which lasted for a week, was held for the purpose of showing to specially invited electrical engineers in the Midlands the advantages and special techniques involved in the installation and jointing of the impregnated

**Alderman A. F. Bradbeer, Lord Mayor of Birmingham, the Lady Mayoress and Mr. P V. Hunter at the opening of the demonstration**

pressure cable. The Lord Mayor, who was accompanied by the Lady Mayoress, was welcomed by Mr. P. V. Hunter, C.B.E., director and engineer-in-chief of B.I. Callender's.

Special interest was shown in the world's first 132-kV three-core impregnated pressure cable, but other installations of 66-kV and 132-kV in London, the Midlands and South Wales also attracted attention. Through illness Dr. L. G. Brazier, B.I. Callender's research laboratory manager, was unable to attend and his paper on "The Development of the Impregnated Pressure Cable" was read by Mr. J. Temple Hazell, A.M.I.E.E. Mr. D. T. Hollingsworth, A.M.I.E.E., of the Research Department, contributed a paper on "Pressure Cable Joints and Sealing Ends."

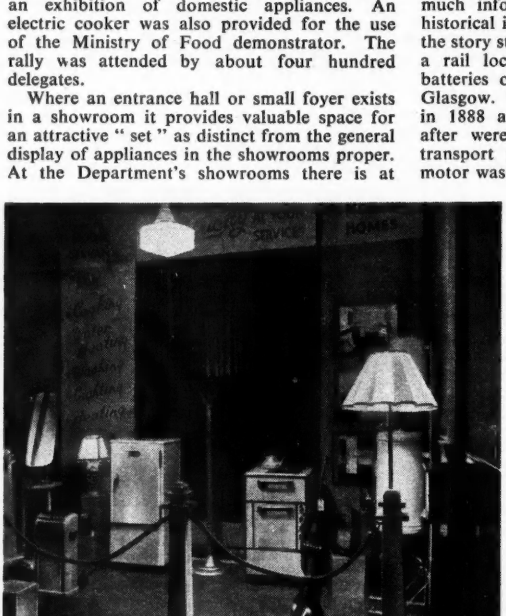
The making of a cast plumb on a 132-kV single-core cable and the application of paper tapes to a 132-kV three-core cable joint were demonstrated and the B.I. Callender film showing the jointing of the 132-kV three-core impregnated pressure cable was shown.

## Sheffield Activities

WHEN the film "Piccadilly Incident" was recently shown in one of the large cinemas in Sheffield, the Corporation Electricity Department, in co-operation with the cinema management, staged an attractive exhibition of domestic electrical appliances in the foyer of the cinema, which is also used as a waiting hall.

The Department recently co-operated in a one-day Food Leader Rally and Exhibition held at Victoria Hall, Sheffield, by arranging an exhibition of domestic appliances. An electric cooker was also provided for the use of the Ministry of Food demonstrator. The rally was attended by about four hundred delegates.

Where an entrance hall or small foyer exists in a showroom it provides valuable space for an attractive "set" as distinct from the general display of appliances in the showrooms proper. At the Department's showrooms there is at present a display piece concerned with electric water heating, but the complete display can be changed with ease to illustrate any other electrical activity.



**Sheffield Electricity Department's display at a recent Food Leader Rally**

The electricity showrooms were severely damaged in the air raids of December, 1940, and although the ground floor has been restored it has not been possible to replace the demonstration theatre on the second floor. The Department has therefore hired the Library Theatre, Sheffield, for one afternoon a week. Regular weekly demonstrations are held at which the average attendance is eighty. As a variation from cooking demonstrations the Department, in conjunction with the Rinso Wash Testing Laboratories, recently gave a public demonstration of "Modern Methods of Clothes Washing." At the conclusion of the demonstration the members of the audience were invited on to the stage to inspect the appliances.

## Electric Transport 1896–1946

A BOOKLET of 66 pages containing 32 illustrations entitled "Electric Traction Jubilee," by J. H. Cansdale, published by the British Thomson-Houston Co., Ltd., contains much information that is of more than the historical interest denoted by its title. Actually the story starts in 1839 when, the author relates, a rail locomotive was operated by primary batteries on the line between Edinburgh and Glasgow. The introduction of the carbon brush in 1888 and totally enclosed motors shortly after were major factors in making electric transport practicable, but the weight of the motor was then over 100 lb per H.P. compared with under 12 lb for a modern trolley-bus motor.

After tracing the effects of improvements in materials and design technique on performance, the author discusses progress in motor control and the era of tramways (which he maintains is still the most efficient system for heavy city services involving frequent stops) and gives particulars of the London Underground and Southern Railways and of B.T.H. railway electrification overseas supplemented by particulars of substation and converting equipment. A chapter on trolley-bus developments shows that vehicle to be, in nearly every case, the obvious successor of tramcars as these become obsolete.

Other chapters deal with battery vehicles on road and rail and electric locomotives in industry. In regard to the future the scope for railway electrification is illustrated by the consideration that only 3 per cent of the world total of 750,000 route miles is now operated electrically. The conditions under which Diesel-electric systems are suitable are stated. On the roads the trolley-bus is seen as the public's choice for passenger transport and the battery vehicle as the backbone of local delivery service.

## Power for Pumping Stations

The Metropolitan Water Board has decided that the normal drive for machinery to be installed in well stations and re-pumping stations should be by means of purchased electric power, with Diesel engines for stand-by and load-relieving purposes.

# What is Ohm's Law?

## Some Textbook Definitions

**By G. W. Stubbings,** B.Sc., A.M.I.E.E.

A RECENT I.E.E. paper contained a statement that a certain resistance material was characterized by a striking departure from Ohm's law. This statement was criticized by a well-known electrical engineer on the ground that Ohm's law is not a law of materials but of the electric circuit, and that it is a rule-of-three relation between the quantities usually denoted by the symbols E, I and R. The idea of Ohm's law implicit in the statement about the resistance material is that the law may or may not be true, and that compliance with the law is a definite physical property or characteristic of a material, referring to its ability to conduct electricity. The implication in the criticism of this statement is that Ohm's law is true for all electric circuits, and that it is really a definition of the resistance of a circuit to the passage of electricity, the ohms measure of the resistance being the ratio of volts of pressure to amperes of current. These two views of the nature of Ohm's law are fundamentally different in character.

### Symbolic Form without Qualification

It would seem to be a very simple matter for a thinking student, confronted with these two conflicting views, to discover which is the true one by turning to any standard electrical reference work. But this is not the case, and the writer was surprised, on looking into the books on his shelves, to discover the many ways in which so important a law of electrical science is formulated. In two modern English reference books Ohm's law is stated in the symbolic form $E = IR$ and its algebraic equivalents, without comment or qualification. In a popular American elementary textbook the law is said to be that the current in amperes can be found by dividing the pressure in volts by the resistance in ohms. An older and once well-known book, S. P. Thomson's classic "Elementary Lessons in Electricity and Magnetism," gives a practically equivalent statement of the law.

Again, a recent article by a well-known educationist contains the following statement about Ohm's law: "It is perhaps best to consider the law a statement about energy-consuming parameters, namely, that the numerical value of the resistance R in ohms is equal to the quotient of voltage V and current I respectively in volts and amperes. Every resistance then obeys Ohm's Law." On the other hand, a modern college textbook on "Electricity and Magnetism" gives the following statement of Ohm's law: "If the temperature of a conductor be kept constant the ratio of the steady direct P.D. applied to its ends to the steady direct current flowing through it is constant, and this constant measures the resistance of the conductor." Here it is stated that the law is an assertion of the constancy of the E/I ratio, subject to the condition of constancy of temperature.

An old classic, J. J. Thomson's "Elements of Electricity and Magnetism," is more precise still; in this book the statement of Ohm's law is that $E = IR$, where R is the resistance of a wire through which I flows; R is independent of I and depends only on the shape and size of the wire, the material of which it is made, and upon its temperature and state of strain. The law is stated to be true of metals and electrolytes, but not of the passage of electricity through rarefied gases.

### Statements in Elementary Textbooks

It is singular that the statement of Ohm's law is generally fuller and more precise in elementary textbooks on general physics than in works of similar grade on electrical technology. For instance, in a modern American popular book on general physics, the law is given in the usual symbolic form $I = E/R$, but there is a clear statement that the essence of the law is that R is usually constant. In an older English classic, Watson's "Text Book of Physics," the statement of Ohm's law is practically the same as in J. J. Thomson's work. It is noteworthy that, of all the books consulted, only one, the college textbook, states explicitly that the law $I = E/R$ applies directly to circuits in which the applied pressure is steady, that, in short, resistance in ohms is the ratio of steady pressure to the steady current it produces.

This survey of a small but fairly representative sample of scientific books brings out the two views of the nature of Ohm's law—the one that it is virtually the assignment of a

name to the E/I ratio, and the other that for certain materials the ratio E/I is constant and independent of I, provided that all other conditions of the electric circuit remain constant. On the one view of the law it is on the same footing as the rules that define the quantities impedance and permeability; on the other, the law is an empirical generalization which has been found by experiment to be very accurately true for certain materials and circuits. Ohm is famous for the lengthy and skilful research work he carried out to establish the truth of the law known by his name. It does not require patient research to define and give a name to a ratio, and the object of Ohm's research and the essence of his law is the constancy of the E/I ratio and its independence of I, other physical conditions remaining constant. The skill displayed by Ohm in establishing his law can be fully realized only after reflection on the rudimentary state of the technique of electrical measurements in his time. Ohm's law is plainly a law of materials, and an assertion that, for metals, resistance is independent of current.

### Possible Inaccuracies

Ohm's law has been found by later experiments to be true for metals to an accuracy of one part in 100,000. This degree of accuracy may apply only to conductor current densities for which the conductor temperature can be maintained accurately constant. It is possible that the law may not be so accurate for exceedingly small or for very large currents in metallic circuits. There may be a similar doubt about the accuracy of the law as applied to insulators, unless the leakage conductance through the insulator is electrolytic in character. Ohm's law, as a statement of the constancy of the E/R ratio is known to be untrue for gaseous discharge circuits and also for certain non-metallic conductors. The equation $I = E/R$ can certainly be said to apply in a sense to to such circuits, but only with the qualification that R is some unknown function of I.

Ohm's law, as a law of electrical science, is therefore anomalous in that it is true only for circuits to which it applies and that it breaks down in conditions for which it is not true. Notwithstanding this anomaly, the practical importance of the law in electrical calculations is immense when expressed in the form that the resistance of a metallic circuit is constant with constant temperature.

Ohm's law is unfortunately taught to most electrical students as a kind of truism, a formula for the working out of simple circuit calculations, and rarely is the real nature of the law explained or the work entailed in its establishment touched upon. Most commercial methods of measuring electrical quantities depend in some way or other on an application of Ohm's law, and a useful exercise for a student is to devise a method of approximately testing the validity of the law *de novo* and without assuming its truth.

---

## Supply Workers' Wages

### National Agreement Negotiated

ON January 17th, an important agreement was made by the National Joint Industrial Council for the Electricity Supply Industry, standardizing the wage rates and working conditions of all manual workers engaged in the electricity supply industry throughout Great Britain and Northern Ireland, with the exception of those in the London area.

The agreement comes into force on the commencement of the first full pay period following February 1st, 1947, and takes the place of thirteen district agreements. This is the final stage in the evolutionary process which has been going on since the year 1919 when the District Councils standardized the wage rates and working conditions in their areas. The abolition of the great diversity between the district agreements will remove grievances arising from men being paid different rates for doing the same work under the same conditions. The District Councils will continue to deal with questions concerning the application of the agreement in their areas, and to act generally as part of the conciliation machinery.

The national agreement is a compromise between the rates and working conditions of the District Councils, and provides for a marked improvement. The system of "A" and "B" zone rates is preserved in districts where zoning is in operation, and the new "A" zone rates in general range from 30d an hour for a fitter to 24d for a labourer, with a margin of ¾d below those rates for "B" zone. There are a few grades such as installation inspectors, switchboard and substation attendants, who receive rates higher than 30d. These figures are day rates, and the addition of 3d an hour for all hours worked by shift workers which has been in operation for some time past is preserved. A new feature of the working conditions is the abolition of time and a quarter as the minimum overtime rate, and the substitution of time and a half. The rates are stabilized until October 1st, 1947.

At the National Council meeting on January 17th, Mr. E. W. Bussey, and Sir William Walker, as chairman and vice-chairman respectively, congratulated the Council on a great contribution to the good of the industry.

# ELECTRICITY SUPPLY

## Abnormal Output at Hackney.

## St. Lawrence Waterway Project.

**Ashton-under-Lyne.**—SALE OF REDUNDANT PLANT.—It was stated at a meeting of the Town Council that when Ashton ceased to be a selected station the C.E.B. gave the Council the plant, which was assumed to be worth £ .000. When tenders were first invited the highest was £4,260, and when they were invited a second time the best offer was £6,050. But the chairman of the Electricity Committee told the Council that when a minute concerning the sale of the plant had been implemented it would be found the plant had realized £15,928, and there was still a certain amount to be sold.

**Aylesbury.**—SUPPLY TO WESTCOTT EXPERIMENTAL ESTABLISHMENT.—The Corporation has been authorized by the Ministry of Works, Contracts Branch, to proceed with a scheme to provide an electricity supply of 15,000 kW to the Government Experimental Establishment at Westcott, Bucks., at an estimated cost of £96,870. The scheme includes the erection of 6¾ miles of 33-kV duplicate-conductor steel tower transmission line, 2¾ miles of 33-kV cable and two 10,000-kVA, 33/11 kV transformers.

LOAN SANCTION.—The consent of the Electricity Commissioners has been obtained to the borrowing of £52,930 for specified and unspecified works, including mains extensions, meters and consumers' apparatus.

**Bedford.**—LOANS.—The Corporation is applying for sanction to borrow £13,773 for the augmentation of the electricity supply in Sandy, and £15,710 for extensions and alterations to meet the increased demand for electricity by local brickyards.

**Brighton.**—DISTRIBUTION WORKS.—At a cost of £12,430 the Electricity Committee is to provide a supply to the Sunninghill estate, Hove. To meet increasing demands in the vicinity of the Palace Pier and the reopening of the Aquarium and nearby hotels, a substation is to be constructed in King's Road at a cost of £3,534. Premises are to be purchased in North Road to relieve the congestion at the North Road distribution centre.

STREET LIGHTING.—The Electricity Committee recommends the provision of a new lighting system in Stanford Avenue at an estimated cost of £4,500.

**Cheltenham.**—HOUSING DEVELOPMENT.—Electricity is to be supplied to the Shurdington estate at a cost of £1,209.

**Chester.**—FRINGE ORDER.—The Electricity Committee is seeking a Fringe Order to supply electricity to farms and cottages at Harthill.

LIGHTING SCHEME.—The Watch Committee recommends a street lighting scheme for Newtown at an estimated cost of £2,370.

**Croydon.**—POWER STATION EXTENSIONS.—The Electricity Committee is to proceed with the second section of the power station at an estimated cost of £2,916,400. The building is being designed so as to be capable of extension to house two further 52,500-kW sets.

SUPPLY TO HEATHFIELD ESTATE.—Sanction has been obtained to borrow £17,321 for the provision of a supply to the Heathfield estate.

**Dundee.**—BRITISH ASSOCIATION MEETING.—The Corporation's main trading undertakings are to subscribe £1,000 towards the expenses of the British Association meetings in the city. Electricity Department will contribute £250.

**Fulham.** — IMPROVING DISTRIBUTION. — The Borough Council Electricity Committee has approved an estimate of £170,000 for the further standardization and reinforcement of the local distribution system.

**Glasgow.**—EXTENSIONS.—The Electricity Committee is seeking sanction to borrow £130,740 for extensions to cope with the increasing industrial loan in various parts of the city.

ACCOUNTING MACHINERY.—Application is to be made for permission to borrow £16,583 for accounting machinery for the Electricity Department.

**Hackney.**—ABNORMAL OUTPUT.—Details are given in the report of the Electricity Committee showing the abnormal output of electricity for the five weeks ended December 28th last. The weekly output to Hackney varied between 15 and 41 per cent in excess of the previous year and to Stoke Newington the increase was between 18 and 51 per cent. In the week ended December 21st 7·7 million kWh was generated at the Millfields Road station—130 per cent more than in the corresponding week of 1945.

HIRE OF APPARATUS.—A joint report by the borough electrical engineer and the borough treasurer gives the approximate economic weekly rental of an electric kettle as 4d. and of an iron as 2d., whereas at present the charges are 2d. and 1d. respectively. The Electricity Committee is of the opinion that the higher rates should be adopted for agreements entered into after February 1st.

**Islington.**—CENTRAL DEPOT.—At its meeting on January 17th the Borough Council approved the provision of canteen facilities and improvements to the loading bay in the new central depot recently acquired at North Road. From this depot will operate the distribution and public lighting and the newly-instituted consumers' service section, and in addition a central stores and sub-stores for all sections of the Department. The approximate cost is £2,000.

SHORTAGE OF RAW MATERIALS.—The Council decided to support Fulham's resolution that

letters be sent to the President of the Board of Trade and Members of Parliament for Islington asking that all steps possible should be taken to alleviate the problem arising from the acute shortage of raw materials for domestic electrical apparatus and its serious consequences, particularly in regard to the nation's housing programme.

METER TESTING.—It was agreed to purchase 3-phase meter testing equipment at a cost of approximately £2,000.

**Llandudno.**—NEW TWO-PART TARIFF.—The Electricity Committee is to consider the adoption of a new two-part (lighting and power) tariff throughout the district. This follows a decision to ask the Electricity Commissioners' approval to charge tenants of prefabricated houses 4d. per kWh in view of the fact that the houses have only one meter and the charge had previously been on the higher lighting rate.

**St. Pancras.**—SALE AND HIRE OF KETTLES.—At present the minimum cash price of any article which the Electricity Department may sell on hire-purchase terms is £4. The Electricity and Public Lighting Committee recommends that an exception shall be made in the case of electric kettles. A rent of 3d. per week is to be charged for new kettles let out on simple hire, the facility being confined to domestic consumers.

OVERLOADING.—There having been serious overloading of the high-voltage network in the Tottenham Court Road area, the Electricity and Public Lighting Committee is applying for sanction to borrow £10,705 for laying additional h.v. mains from Regent's Park substation to Percy Street.

HOUSING SCHEMES.—In connection with the St. Pancras Way and Cromer Street housing schemes application is to be made for sanction to borrow £14,005 for transformer substations.

## Overseas

**Australia.**—SUPERPOSED PLANT.—At a recent meeting of the Institution of Engineers Mr. F. Sykes, power superintendent of the Electric Light & Power Corporation, Ltd., gave a description of the new coal-saving technique known as "superposing," which has been applied at the Balmain power house. This had been found, at the end of a six months' test, to have increased the station's capacity by about 20,000 kW and to have effected substantial improvement in coal economy.

**Egypt.**—ASWAN DAM SCHEME.—The Egyptian Cabinet has approved a proposal by the Ministry of Public Works to appoint three new experts, American, French and Swedish, to join the group of British experts formed to study the Aswan Dam scheme.—*Reuter's Trade Service* (Cairo).

**Portugal.**—HYDRO-ELECTRIC SCHEME.—A £4,000,000 hydro-electric development which is being planned for Northern Portugal envisages the damming of the rivers Cavado and Rabagao and their tributaries to form four artificial lakes at Venda Nova, Paradela, Lavandriras and Canacida, and the erection of the corresponding generating stations. The first stage of the scheme—the erection of the dam at Venda Nova with its generating station at Vila Nova—is already well under way and it is hoped to have the foundations of the dam ready by the middle of this year. This dam, which it is claimed will be amongst the largest in Europe, will be some 100 ft high and 300 yd long and will carry a 30-ft national highway. The artificial lake thus formed will be nearly twenty miles long and will have a useful capacity of some 6,000 million gallons of water. Negotiations have already been concluded in England for the provision of the generating plant which is designed for a permanent output of 150,000,000 kWh annually, and will have an installed power of 108,000 H.P. It is hoped that the first stage, the cost of which is estimated at £1,600,000 will be completed by December, 1949.—*Reuter's Trade Service.*

**South Africa.**—DEVELOPMENT SCHEME.—An application for a licence to supply electricity to a large area in the heart of the Union, including new goldfields in the Free State, has been made by the Electricity Supply Commission to the Electricity Control Board. This is the area where the recent new strike at Odendalsrust was made.—*Reuter.*

**United States.**—ST. LAWRENCE PLAN REVIVED.—Discussion of the plan to build a 2,000-mile inland seaway through the St. Lawrence River and the Great Lakes, estimated to cost more than $500,000,000 (£125,000,000) has been revived. The scheme would involve a large power development. President Truman is reported to be ready to push the Seaway Agreement, signed by Canada and the United States in 1941, through Congress this year. The Canadian authorities, too, are hopeful, but Canada made it clear when the agreement was signed that it would not be presented to Parliament until after Congress had approved it. A previous treaty, approved by the Canadian Parliament, was rejected by the U.S. Congress. Under the terms of the agreement, an estimated 2,200,000 H.P. would be developed on the International Rapids section of the river, between Ontario and New York State. Half of this power would go to Ontario and the other half to New York.—*Reuter* (Ottawa).

# RADIO and TELEPHONY

**Great Britain.**—RADIO RELAY SERVICES.—The Twickenham Highways Committee recommends granting an application by British Relay Wireless, Ltd., to provide a relay service in the district, the company to pay the Council 6s. 10d. per annum in respect of each subscriber.

St. Andrew's Town Council at its last meeting appointed a sub-committee to meet the Maclaine of Lochbuie who has asked permission to establish a radio relay station in the town.

# Colour Films

## Plant Alterations at Pinewood to Meet Increasing Production

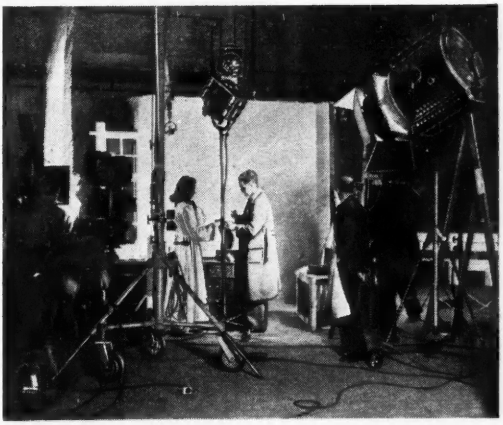
THE increasing use of the "Technicolor" process in film production is resulting in some interesting modifications and additions to the electrical plant at the Pinewood Studios at Iver Heath. In making films in colour a higher intensity of illumination is needed because the light collected by the camera lens is required to expose three negatives each provided with a primary colour filter. On the other hand the periods in which the actual "shooting" of the films occur are liable to be much more widely spaced than is the case with the ordinary black and white films. This means that provision has to be made for supplying heavier loads, which on account of their intermittent use have an extremely poor load factor, sometimes amounting to no more than 10 per cent. In fact, it is not uncommon for a set requiring a load of 2,000 kW to account for only 2,000 kWh in a day.

If a public supply of electricity were taken this state of affairs would be even more onerous, due to the operation of the maximum demand tariff against a very small consumption. As it is, however, only a very small portion of the electrical requirements of the studios is taken from the public supply of the Metropolitan Electric Supply Co., a maximum demand of 100 kVA meeting special needs for 415/230-V a.c. supplies. The bulk of the electricity is used at 230 or 115 V d.c. and is generated on the premises by five English Electric Diesel sets of a total capacity of 2,360 kW with full heat-recovery plant, details of which were given in our issue of October 16th, 1936, soon after the opening of the studios.

In Technicolor production, to overcome the disadvantages of having to keep generating plant running throughout the working day to meet the sudden heavy but short period demand, Mr. F. V. Hauser, engineering and electrical adviser to D. & P. Studios, Ltd., has recently arranged for the provision of a D.P. storage battery installation, comprising 118 cells each of sixty-nine plates, with a capacity of 10,200 Ah at the 10-hour rate. This battery, which is believed to be the largest of its type in the country, will be used in conjunction with a fully automatic reversible English Electric booster of special design.

Normally only the base load as estimated by the studio engineers will be met by the generating plant. When the load exceeds the output of the running plant the battery will automatically discharge on to the line: when the load is reduced the generators will automatically commence to charge the battery, the amount of charge depending on the surplus capacity available.

The arrangements are such that the charging current is carefully regulated to apply to the state of discharge of the battery; that is, when the battery is in a fully discharged condition, the charging current will be at the full rate, provided of course that the running plant is arranged to give this output. When the battery is partially charged, charging current is reduced so that on reaching 2·7 V per cell, the charge is dropped to zero. The automatic booster is not expected to be available until the



**In making colour films a very high intensity of illumination is required. In this small set Miss Deborah Kerr is seen preparing for a close-up for the film "Black Narcissus" in which 50 kW of lighting is in use**

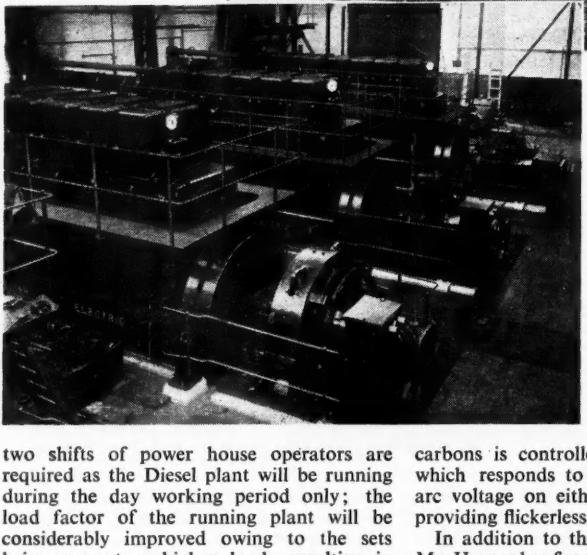
spring, and in the meantime charging must be effected by the running of two generators in series.

At times of high loading when Technicolor production requires the full resources of the power house, the battery can be discharged at the one-hour rate of 5,100 A at 230 V or 10,200 A at 115 V, the working pressure. As the load required for the shooting of Technicolor sets is of the intermittent character previously referred to, the battery can be re-charged during the intervals between each scene so that in effect an additional 10,200 A is regularly available.

The advantages of this method of working are considerable. The plant need not be run during the night and weekend, thus avoiding specially uneconomic load conditions; only two shifts of power house operators are required as the Diesel plant will be running during the day working period only; the load factor of the running plant will be considerably improved owing to the sets being run at a higher load, resulting in reduced oil costs; and the use of the battery for short-term high-loading conditions in addition to the absence of night running will considerably reduce maintenance and extend the life of the Diesel plant.

These advantages will become more apparent as the output of the studios expands, and as other studios are built when conditions permit. In addition to the battery installation a further 1,000-H.P. 8L English Electric vertical Diesel engine with 660-kW generator is to be added by the spring. This set will be sited on one of the two additional engine beds already provided.

When the studios recommenced operation a year ago after their wartime service with the Crown Film Unit, only the pre-war Technicolor equipment was available. Since that time some hundreds of Mole-Richardson arcs have been provided for Technicolor work at the company's Pinewood and Denham Studios, including the new Mole-Richardson acoustically treated HI arcs and the "Duarc" floodlamps in which each pair of carbons is controlled by a separate motor which responds to the slightest change in arc voltage on either pair of carbons, thus providing flickerless operation.



**This new battery seen in course of installation will greatly improve the load factor and operating conditions of the Diesel generators, three of which are seen on the left. Two additional beds have already been prepared at the far end of the power house, where a further 660-kW set is to be installed and another unit may be added later**

In addition to these new lighting sources, Mr. Hauser has for some time been associated with the development of a new illuminant, the colour-corrected, high-pressure, mercury vapour bulb. At present these lamps are only in the laboratory stage of development, but the results obtained experimentally have been eminently satisfactory and the studio anticipates using them on production shortly.

# FINANCIAL SECTION

## Company News. Stock Exchange Activities.

## Reports and Dividends

**The Westinghouse Brake & Signal Co., Ltd.,** reports a trading profit for the year ended September 30th last of £190,424, as compared with £319,086 for the preceding year. A sum of £106,000 is credited in respect of E.P.T. and after providing £147,000 for income tax the net profit is £209,424, an increase of about £14,000 as compared with 1944-45. The dividend for the year is maintained at 10 per cent, plus a bonus of 4 per cent, general reserve receives £100,000 and pensions account £20,000. The balance carried forward is £99,193 (against £99,192 brought in).

**Radio Rentals, Ltd.**—Presiding at the annual meeting held on January 15th, Mr. H. F. Hunt (chairman) said that the year under review had been one of reconstruction. They had purchased £80,000 worth of new radio sets and in addition had been able to deal with much delayed overhaul and maintenance work on their existing sets and had spent approximately an extra £10,000 on materials in this way as compared with the previous year. They expected in the near future to resume their rental service for television sets and would be able to offer radio gramophones. The subsidiary companies had made a promising start on their reconstruction programmes.

**Brush Electrical Engineering Co., Ltd.**—The company is shortly to submit a scheme to the Capital Issues Committee for a complete merger of manufacturing interests with oil-engine companies whose products are sold by Associated British Oil Engines, Ltd. Four of the companies are already controlled by the Brush Co.

**Redfern's Rubber Works, Ltd.,** propose to pay a final dividend of 5 per cent and a bonus of 5 per cent, making 15 per cent for the year; this compares with 12 per cent last year when the final dividend was 6¼ per cent with a 2 per cent bonus.

**David Brown & Sons (Huddersfield), Ltd.,** report a net profit for the year to September 30th last of £88,216 (against £136,565). The ordinary dividend is reduced from 10 to 5 per cent and £289,034 (£271,836) is carried forward after allocating £50,000 (£75,000) to contingencies.

**William Steward & Co., Ltd.**—At a recent extraordinary meeting a resolution was passed authorizing an increase in capital to £10,000 by the creation of 4,200 additional shares of £1 each to be issued upon such terms and conditions as the directors shall determine.

**The Electrical & Industrial Investment Co., Ltd., reports a revenue of £62,012 for 1946, as** compared with £55,344 for the preceding year, and a net balance of £27,284 (against £22,112). Reserve receives £2,224, and the dividend on the deferred ordinary shares is unchanged at 12 per cent. A sum of £11,310 is placed to undivided profits account (against £9,247).

## New Companies

**Radio Laboratory Development Co., Ltd.**—Registered in Edinburgh January 10th. Capital, £6,000. Radio, electrical, electronic and general consulting engineers, etc. Directors: W. S. Geddes, W. A. G. Cochrane and M. S. McKerrow. Regd. office: Little Breconside, Kirkgunzeon, by Dumfries.

**C. Leeder & Co., Ltd.**—Registered January 17th. Capital, £4,000. Manufacturers of, and dealers in, electrical and mechanical appliances, electrical engineers, etc. Directors: C. Leeder and L. Simpson. Regd. office: Cooper Street, Mills, Burnley.

**Broadheath Electrical Co., Ltd.**—Registered January 15th. Capital, £500. Electrical engineers, manufacturers of, and dealers in, motor and aircraft accessories, etc. Directors: E. Critchley and W. O. Davenport. Regd. office: 22a, Bridgewater Road, Altrincham, Cheshire.

**Ferring Electrics, Ltd.**—Registered January 16th. Capital, £1,000. Electrical, radio and television engineers, electricians, etc. Directors: Mrs. Rose Roberts, F. B. West, H. Jackson and F. A. Burtenshaw. Regd. office: 2, The Pantiles, Ferringham Lane, Ferring, Sussex.

**A. Tanner, Ltd.**—Registered January 20th. Capital, £1,000. To acquire the business of an electrical dealer carried on by Abraham Tanner at 13, Foscote Road, Hendon, N.W.4. Directors: A. Tanner and Hanna Tanner. Regd. office: 13, Foscote Road, Hendon, N.W.4.

**Glyn Nuttall, Ltd.**—Registered January 20th. Capital, £1,000. Electrical engineers, etc. Directors: J. Glyn Nuttall and T. H. Nuttall. Regd. office: 187, Wavertree Road, Liverpool.

**Dymo, Ltd.** — Registered January 15th. Capital, £1,000. Electricians, engineers, etc. Directors: R. N. Ainsworth, G. N. Ainsworth and A. Hanson. Regd. office: 90, Deansgate, Manchester, 3.

**Thomas Low (Electrical Engineers), Ltd.**—Registered January 14th. Capital, £1,000. Directors: Emma R. Low and T. W. Low. Solicitors: W. F. Gillham, 3, Gracechurch Street, E.C.3.

**Radio Trade Supplies (Southall), Ltd.**—Registered January 18th. Capital, £3,000. To acquire the business of a manufacturer of radio

and electrical components now carried on by J. A. G. Gillespie at 60, North Road, Southall, as "Radio Trade Service." Permanent directors: J. A. G. Gillespie and Mrs. M. J. Gillespie. Regd. office: 60, North Road, Southall, Middlesex.

**Radiolight Plumstead Industries, Ltd.**—Registered January 11th. Capital, £2,000. To acquire the business of a radio and electrical engineer carried on by Walter J. G. Powell at 60, Herbert Road, Plumstead, S.E.18. Permanent managing directors: W. J. G. Powell and R. F. Jago. Regd. office: 60, Herbert Road, Plumstead, S.E.18.

**Barrwood Manufacturing Co., Ltd.**—Registered January 7th. Capital, £1,000. Designers and manufacturers of, and dealers in, wireless and electrical apparatus and accessories, etc. Directors: C. C. Poole and W. E. Holland. Regd. office: Hamstead Road, Great Barr, Birmingham.

**F.W.D. (Sales), Ltd.**—Registered January 7th. Capital, £100. Manufacturers, importers, exporters and repairers of, agents for, and dealers in, wireless apparatus, electrical instruments and accessories, etc. Subscribers: E. S. Reuben and D. Harrison. Regd. office: 106, Heath Street, Hampstead, N.W.3.

**Radio Kits Co., Ltd.**—Registered January 7th. Capital, £2,000. Manufacturers of, and dealers in, wireless receiving, transmitting and television apparatus and radio kits, electrical and mechanical appliances, etc. Directors: G. S. Lee and Mrs. Joan Lee. Regd. office: 3, Hollingbury Place, Brighton.

**Bee Appliances, Ltd.**—Registered January 14th. Capital, £5,000. Manufacturers, dealers and servicers of mechanical, electrical and radio equipment, etc. Permanent directors: J. Bee, Margaret Cooper and S. Seed. Regd. office: Sunnybank Farm, Hambleton, Lancs.

**Western Radio & Electric Wholesales, Ltd.**—Registered January 7th. Capital, £2,000. Wholesale and retail electrical goods suppliers and sundriesmen, electrical and general engineers, dealers in radio apparatus, etc. Directors: G. T. S. Reekie and Mrs. Kathleen A. Reekie. Solicitor: Philip A. Carne, Plymouth.

**Denalectrix, Ltd.**—Registered January 8th. Capital, £1,000. Electrical and radio engineers, etc. Directors: F. G. Alexander, A. M. Davey, A. T. Dean and H. W. Burt. Regd. office: 41, High Street, Stanstead Abbots, Ware, Herts.

**A. Cooper & Sons, Ltd.**—Registered December 12th. Capital, £2,000. Manufacturers of, and dealers in, wireless and television sets and components, electrical appliances, etc. Directors: A. Cooper, S. Cooper and R. Cooper. Secretary: S. Cooper. Regd. office: 340, High Street, Chatham.

**David Phillips (Successors), Ltd.**—Registered January 21st. Capital, £3,000. To acquire all or part of the business carried on by the Steel City Supply Co., Ltd., at 125, Tottenham Court Road, W.1 as "David Phillips & Co." manufacturers and electrical engineers. Directors; T. Oxley and Marjorie R. Oxley. Regd. office: 3, Cambridge Street, Sheffield.

**Harley Installations, Ltd.**—Registered January 21st. Capital £1,000. Manufacturers, fitters and hirers of, and dealers in, electrical and mechanical apparatus, etc. Directors: Kitty Y. Adcock and F. W. Adcock. Secretary: Eileen R. Pinnell. Regd. office: 22, Charing Cross Road, W.C.2.

**Newo Manufacturing Co., Ltd.**—Registered January 20th. Capital, £500. To acquire the business of a manufacturer of the "Newo" electric lighter carried on at East Cowes, I.O.W. by J. Owen as the "Newo Manufacturing Co." Directors: J. Owen and F. P. Abraham. Regd. office: 29, Lugley Street, Newport, I.O.W.

**Hauffman Electric Co., Ltd.**—Registered January 22nd. Capital, £600. To acquire the business carried on by R. J. Homan and A. W. Byatt as the Hauffman Electric Co. Directors: R. J. Homan and A. W. Byatt. Regd. office: 3/5, Station Parade, Sheen Lane, East Sheen.

## Increases of Capital

**Electronic Products (Glos.), Ltd.**—Capital increased by £10,000 beyond the registered capital of £5,000.

**Anson Lee, Ltd.**—Increased by £3,000 beyond the registered capital of £1,000.

## Bankruptcies

**K. G. Burfield,** 28, Hamlet Court Road, Westcliff-on-Sea, Essex, restaurant proprietor, described in the receiving order as at "Espere," Couchmore Avenue, Clayhall Avenue, Ilford, Essex, electrical contractor.—Last day for receiving proofs for dividend February 4th. Trustee, Mr. J. M. Clarke, 20, Eaton Place, London, S.W.1.

**D. W. J. Prentice,** electrical engineer, 59, Brecon Road, Fulham, S.W.—At the London Bankruptcy Court on January 21st, Mr. Registrar Parton granted an immediate order of discharge, subject to the debtor's consenting to a judgment for £100.

**N. Doffman,** radio and electrical dealer, 75A, Oxford Gardens, Kensington, London, and lately carrying on business at 163, Ladbroke Grove, Notting Hill Gate, London.—Receiving order made January 14th, 1947, on a creditor's petition. First meeting to-day (Friday) and public examination March 13th, both at Bankruptcy Buildings, Carey Street, London, W.C.2.

**S. Hancock,** electrical engineer, carrying on business as S. Hancock & Co., at Clyde Street, Holt Town, Manchester.—Supplemental dividend of 10½d. in the £, payable February 11th at the Official Receiver's Office, 20, Byrom Street, Manchester.

# STOCKS AND SHARES

STOCK EXCHANGE markets and prices have suffered severe relapses owing to several factors, of which the latest Government warnings, embodied in last week's White Paper, form the principal constituent. The industrial market took the principal force of the selling movement on the part of the public; prices in most sections fell sharply. Money known to be awaiting employment has been held back, presumably on the owners' assumption that prices may go lower still. A little support has been rendered here and there, not sufficient, however, to stem the volume of selling that has occurred. The weakness extended from one end of the House to the other, industrials, as already mentioned, being amongst the chief sufferers.

### Lacking in Logic

It may be argued that, logically, an increased effort on the part of producers, and a quickening of the wheels of industry, should lead to expansion of profits, higher dividends and progressive trade. For prices to fall, on the prospect of additional activity, is somewhat unreasonable and illogical. This is, nevertheless, what happened, but the argument remains, and when the present fears have been dissipated—as they will be in due course—there will be a resumption of the demand for stocks and shares.

### A Month's Changes

By comparison with the prices of December 18th last, the ordinary shares of Home electricity supply companies make a mixed showing. Rises and falls are fairly well balanced. During the period, publication of the Electricity Bill brought about a sharp general fall which was succeeded by a partial recovery. The principal rise during the period has been a jump of 28½ points in Cable & Wireless ordinary. The price rose from 118 to 156, from which it fell back to 146½. The preference, however, shows no net change on the month. Thomas Tilling are 1s. 9d. down at 58s. 9d., repetition of the usual 10 per cent dividend having caused a shade of disappointment.

### Stock Exchange Activity

Equipment and manufacturing shares are mostly higher. The decline that followed upon the Government's warnings, had the effect of reducing fairly considerable rises that had previously taken place. The volume of Stock Exchange business continues to be of substantial dimensions; the number of bargains recorded on a single day, during the December-January period, achieved a high record since the outbreak of war.

### How "Compensation" Works

Loss of income is one of the most unpleasant features of nationalization to the holder of shares in electricity supply companies which fall under the harrow. The extent to which this loss operates may be illustrated by reference to Metropolitan Electric Supply ordinary shares. The holder of 100 shares received 9 per cent dividend for last year, and the compensation price which he will receive for his holding is 48s. His 100 shares at 48s. will be represented by £240, and, if he receives this amount in new stock upon which the dividend is 2½ per cent, the dividend will come to £6, showing a decrease of £3, less tax in both cases.

### Reduction of Income

Taking Edmundsons as another illustration, the holder of 100 shares has been receiving £6 a year and upon his 100 shares being compensated by allotment of £157 10s. of a new 2½ per cent stock, the interest on the latter will be £3 18s. 9d., a reduction of £2 1s. 3d. One more instance may be quoted, South Londons, the compensation price for which is 33s. and the present dividend 7 per cent. On the £165 of the compensation stock at 2½ per cent, the dividend is £4 2s. 6d. per cent a reduction of £2 17s. 6d. on the 100 shares. The same method is to be applied to stocks and shares throughout the list, and in every case the compensation stock dividend will show a decreased income to the holder.

### Official and Unofficial

Compensation on the basis of market prices on specific dates is to apply only to those stocks quoted in the Daily "Official" Stock Exchange list. Stocks which appear in the "Supplementary" lists are apparently to be valued by agreement between the Minister and the stockholders' representatives, or, failing that, by arbitration. A distinction of this sort is incomprehensible to anyone familiar with the generally insignificant differences between the character of stocks quoted "officially" and "unofficially." Among the issues quoted in the "Supplementary" lists are the ordinary shares of the Altrincham, Shropshire, Worcester and Staffordshire, Richmond, St. Austell and Woking electricity companies.

### Dividend Outlook

In the Electricity Bill, the supply companies and their stockholders are vouchsafed, so far, no indication, either of the date on which the stocks will be taken over, or of the nature of the compensation stock—except its name. In these two respects they are worse informed than are railway stockholders about their own case, but the electricity position is clearer so far as dividend prospects are concerned. Dividends to be paid on the ordinary stocks between January 10th last and the vesting date are to be limited, either to the rate paid for the last financial year, or to 4 per cent whichever is the greater. In the case of the railways, distributions

(*Continued on page* 235)

# ELECTRICAL INVESTMENTS

## Past Month's Price Changes

| Company | Dividend Previous | Dividend Last | Middle Price Jan. 24 | Month's Rise or Fall | Yield £ s. d. |
|---|---|---|---|---|---|
| **Home Electricity Ordinary** | | | | | |
| Bournemouth and Poole | 12½ | 12½ | 64/– | −1/6 | 3 18 |
| British Power and Light | 7 | 8 | 36/– | +½ | 4 9 0 |
| City of London | 6 | 7 | 32/6 | −1/6 | 4 6 4 |
| Clyde Valley | 8 | 8 | 44/– | +1/6 | 3 12 9 |
| County of London | 8 | 10 | 47/– | +2/– | 4 5 0 |
| Edmundsons | 6 | 6 | 30/– | +1/– | 4 0 0 |
| Elec. Dis. Yorkshire | 9 | 9 | 48/6 | .. | 3 14 0 |
| Elec. Fin. and Securities | 13½ | 15 | 64/6 | −2/– | 4 13 3 |
| Elec. Supply Corporation | 10 | 10 | 48/6 | +2/3 | 4 2 7 |
| Lancs. Light and Power | 7½ | 7½ | 35/6 | +2/– | 4 4 7 |
| Llanelly Elec. | 6 | 6 | 27/6 | .. | 4 7 3 |
| Lond. Assoc. Electric | 4 | 6 | 28/– | .. | 4 5 9 |
| London Electric | 6 | 6 | 29/6 | +2/– | 4 1 3 |
| Metropolitan E.S. | 8 | 9 | 46/– | +1/6 | 3 18 3 |
| Midland Counties | 8 | 8 | 49/– | +1/6 | 3 5 3 |
| Mid. Elec. Power | 9 | 9 | 45/– | −2/– | 4 0 0 |
| Newcastle Elec. | 7 | 7 | 31/– | −3/– | 4 10 4 |
| North Eastern Elec. | 7 | 7 | 34/6 | +½ | 4 1 2 |
| Northampton | 10 | 10 | 49/– | .. | 4 1 8 |
| Northmet Power | 7 | 9 | 46/– | +½ | 3 18 3 |
| Scottish Power | 8 | 9 | 45/– | +3/– | 4 0 0 |
| Southern Areas | 5 | 5½ | 23/– | .. | 4 15 7 |
| South London | 7 | 7 | 31/6 | −1/6 | 4 9 0 |
| Yorkshire Elec. | 9 | 9 | 48/6 | +1/– | 3 14 0 |
| **Public Boards** | | | | | |
| Central Electricity: | | | | | |
| 1963–93 | 3½ | 3½ | 108½ | −1½ | 3 4 6 |
| 1974–94 | 3½ | 3½ | 107½ | −3½ | 3 0 6 |
| London Elec. Trans. | 2½ | 2½ | 101½ | .. | 2 9 3 |
| Lond. Pass. Trans. Bd. | | | | | |
| A | 4½ | 4½ | 127½ | .. | 3 11 0 |
| B | 5 | 5 | 123½ | .. | 4 1 0 |
| C | 3 | 3 | 63½ | −2 | 4 14 6 |
| **Overseas Electricity Companies** | | | | | |
| Atlas Elec. | Nil | Nil | 10/3 | +6d. | — |
| Calcutta Elec. | 6• | 6• | 55/– | +3/9 | 2 3 8 |
| Cawnpore Elec. | 13 | 13 | 61/– | +3/6 | 4 5 6 |
| East African Power | 7 | 7 | 47/– | .. | 2 19 7 |
| Jerusalem Elec. | 5 | 5 | 24/– | .. | 4 3 4 |
| Madras Elec. | 4 | 6 | 41/6 | +4/6 | 2 17 9 |
| Montreal Power | 1½ | 1½ | 23½ | −1½ | — |
| Nigerian Elec. | 10 | 12½ | 55/– | +7/6 | 4 11 0 |
| Palestine Elec. "A" | 5• | 6• | 38/6 | +2/– | 3 2 6 |
| Perak Hydro-elec. | 6 | 7 | 15/– | .. | — |
| Tokyo Elec. 6% | 6 | 6 | 48½ | +4 | — |
| Victoria Falls Power | 15 | 19 | 5 15/16 | +1/16 | 3 5 6 |
| Whitehall Inv. Pref. | — | 6 | 28/– | −6d. | 4 5 9 |
| **Equipment and Manufacturing** | | | | | |
| Aron Elec. Ord. | 15 | 10 | 52/6 | +1/8 | 3 16 2 |
| Assoc. Brit. Eng. | 8 | 12 | 42/6 | .. | 5 13 0 |
| Assoc. Elec.: | | | | | |
| Ord. | 10 | 10 | 74/– | −6d. | 2 14 0 |
| Pref. | 8 | 8 | 48/6 | .. | 3 6 0 |
| Automatic Tel. & El. | 12½ | 12½ | 77/6 | +1/8 | 3 4 5 |
| Babcock & Wilcox | 12 | 12½ | 68/9 | −1/8 | 3 12 8 |

| Company | Dividend Previous | Dividend Last | Middle Price Jan. 24 | Month's Rise or Fall | Yield £ s. d. |
|---|---|---|---|---|---|
| **Equipment and Manufacturing** (*Continued*) | | | | | |
| Baldwin, H.J. (2/–) | 10 | 20 | 12/3 | −3d. | 3 5 3 |
| British Aluminium | 10 | 8 | 46/– | .. | 3 9 7 |
| B.I. Callender's | .. | .. | 48/3 | +1/9 | — |
| British Rola (2/–) | 15 | 15 | 6/6 | −6d. | 4 12 4 |
| British Thermostat (5/–) | .. | 18½ | 23/9 | .. | 3 17 9 |
| British Vac. Cleaner (5/–) | 30 | 20 | 25/– | .. | 4 0 0 |
| Brush Ord. (5/–) | 10 | 4 | 7/9 | .. | 2 11 7 |
| Burco (5/–) | 15 | 20 | 28/9 | −1/8 | 3 9 8 |
| Chloride El. Storage | 15 | 15 | 5½ | .. | 2 18 6 |
| Christy Bros. | 12½ | 17½ | 85/– | .. | 4 2 4 |
| Cole, E. K. (5/–) | 20 | 20 | 32/– | +½ | 3 2 6 |
| Cossor, A. C. (5/–) | 10• | 12½• | 32/– | +1/6 | 1 19 1 |
| Crabtree (10/–) | 17½ | 17½ | 48/– | .. | 3 13 0 |
| Crompton Parkinson Ord. (5/–) | 22½ | 22½ | 33/– | +1/– | 3 7 4 |
| De La Rue | 40 | 45 | 14¼ | +1 | 3 1 0 |
| Decca (1/–) | 100 | 112 | 57/6 | +5/– | 1 19 9 |
| E.M.I. (10/–) | 8 | 8 | 27/6 | +1/8 | 2 18 3 |
| Elec. Construction | 12½ | 12½ | 66/– | +1/– | 3 15 9 |
| Enfield Cable Ord. | 12½ | 12½ | 53/6 | −6d. | — |
| English Electric | 10 | 10 | 66/6 | .. | 2 19 9 |
| Ericsson Tel. (5/–) | 22• | 20• | 56/3 | .. | 1 15 6 |
| Ever Ready (5/–) | 40 | 40 | 50/6 | +6d. | 3 19 4 |
| Falk Stadelmann | 7½ | 10 | 47/6 | +1/8 | 4 4 2 |
| Ferranti Pref. | 7 | 7 | 37/– | .. | 3 15 8 |
| G.E.C. Pref. | 6½ | 6½ | 41/3 | .. | 3 3 3 |
| Ord. | 17½ | 17½ | 102/– | −1/– | 3 8 10 |
| General Cable (5/–) | 15 | 25 | 34/6 | +1/– | 3 13 7 |
| Greenwood & Batley | 15 | 15 | 56/3 | +1/8 | 5 6 5 |
| H.T.A. (10/–) | 12½ | 10 | 21/9 | +6d. | 4 12 0 |
| Heatrae (3/–) | 12½ | 12½ | 7/6 | .. | 5 0 0 |
| Henley's (5/–) | 20 | 20 | 29/6 | +1/– | 3 7 9 |
| 4½% Pref. | 4½ | 4½ | 30/– | .. | 3 0 0 |
| Hopkinsons | 17½ | 20 | 5 1/8 | .. | 3 17 3 |
| Intl. Combustion | 30 | 32½ | 10¾ | | 3 1 0 |
| Johnson & Phillips | 15 | 15 | 83/6 | −½ | 3 11 9 |
| Lancashire Dynamo | 22½ | 22½ | 6 | .. | 3 15 0 |
| Laurence, Scott (5/–) | 12½ | 12½ | 16/– | +6d. | 3 18 2 |
| London Elec. Wire | 7½ | 7½ | 42/6 | +6d. | 3 10 9 |
| Mather & Platt | 10 | 10 | 58/3 | −1/9 | 3 9 5 |
| Metal Industries (B) | 9 | 10 | 63/9 | +½ | 3 2 9 |
| Mid. Elec. Mfg. | 25 | 25 | 9 1/8 | +½ | 2 14 0 |
| Murex | 20 | 20 | 4 11/16 | +1/16 | 4 1 0 |
| Newman Ind. (2/–) | 22½ | 22½ | 9/– | −6d. | 5 0 0 |
| Plessey (5/–) | 20 | 30 | 37/6 | .. | 4 0 0 |
| Power Securities | 6 | 6 | 32/– | .. | 3 15 0 |
| Pye Deferred (5/–) | 25 | 25 | 33/– | +6d. | 3 15 9 |
| Radio & Tel. (2/–) | 25 | 40 | 10/– | .. | — |
| Revo (10/–) | 17½ | 20 | 54/6 | +1/6 | 3 13 6 |
| Reyrolle | 12½ | 12½ | 80/– | .. | 3 2 6 |
| Scophony (5/–) | — | — | 8/– | −6d. | — |
| Siemens Ord. | 7½ | 7½ | 38/6 | +6d. | 3 18 0 |
| Strand Elec. (5/–) | 10 | 12½ | 12/3 | .. | 5 3 1 |
| Switchgear & Cowans (5/–) | 20 | 20 | 26/– | +1/– | 3 17 0 |
| T.C.C. (10/–) | 10 | 12½ | 33/– | .. | 3 15 8 |
| T.C. & M. | 10 | 10 | 59/– | +4/– | 3 7 9 |

(*Continued on next page*)

• Dividends are paid free of Income Tax.